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Solubilities in

SOLUBILITIES

OF

INORGANIC AND ORGANIC COMPOUNDS

A COMPILATION OF SOLUBILITY DATA FROM THE PERIODICAL LITERATURE

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SUPPLEMENT

To the Third Edition
Containing Data Published During the Years 1939-1949 Inclusive

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PREFACE

The publication of this Supplementary Volume to the 3rd Edition of SOLUBILITIES, repeats the pattern adopted in 1927 when a supplement to the 2nd Edition of the compilation was published. This plan has the advantage that the new material appearing in the ten year period after the publication of a complete revision of the book, may be obtained without repurchasing the main body of the data. It, of course, has the disadvantage that it makes it necessary to search in two arrangements to find a desired result. Whether this inconvenience is sufficient to justify the effort and cost involved in making a complete revision at each ten year interval, is open to question.

In collecting the solubility data from the periodical literature, the plan of perusing the journals instead of obtaining references from abstracts and indexes of the literature has been followed as in previous years. By means of microfilm copies of the original papers it has been possible to classify the material in advance in accordance with the systematic plan of its presentation. The microfilm copies also offer the advantage that close contact with the library is not necessary for verifying the source material, and the work of composing the text can be performed wherever found most convenient.

As in the case of the principal volumes of the 3rd Edition, the data has been separately assembled in an Inorganic and an Organic section. The former has been compiled by the junior and the latter by the senior author. In addition there is also included a section on Ternary Systems Yielding Two Liquid Layers, compiled by Dr. Alfred W. Francis of the Socony-Vacuum Oil Co., and a chapter on Recent Contributions to the Theory of Electrolyte Solubility, by Dr. Roger G. Bates of the U.S. National Bureau of Standards. The one provides the basis of a practical application of solubilities to the solution of industrial problems, and the other reviews the present state of knowledge concerning the theoretical interpretation of the phenomena of solubility.

Since the publication of Volumes 1 and 2 of the 3rd Edition of SOLUBILITIES in 1940 and 1941 respectively, the ownership of the book has been transferred to the American Chemical Society, which has assumed responsibility for the publication of the present Supplementary volume and will arrange for any subsequent editions of the work that may be found necessary

Atherton Seidell

November 1, 1951

William F. Linke

ARGON

SOLUBILITY OF ARGON IN WATER

Lawrence, et al (1946) reviewed the work of Estricher (1899), Von Antropoff (1910, 1919), Valentiner (1927, 1930), Lannung (1930), and Behnke and Yarbrough (1939) on the solubility of Argon in water and drew a smooth curve through the points given by all the authors. In addition, determinations were made by Ramsey (1895) and Winkler (1906), but the agreement among all the various results is not good. The following data were read from the curve of Lawrence, et al., and are averages of the data of the above authors.

t°	β	t°	β	t°	β
0°	0.056	25°	0.033	50°	0.025
5°	.048	30°	.030	55°	.024
10°	.043	35°	.029	60°	.023
15°	.039	40°	.027	65°	.0225
20°	.035	45°	.026	70°	.022

SOLUBILITY OF ARGON IN LIQUID OXYGEN

(Fastovskii and Krestinskii, 1942)

Temp °K	Mole fraction Argon
72.30°	0.558
75.99°	.668
77.20°	.734
79.09°	.802
82.09°	.927*

*Inglis (1906)

The solid-liquid equilibria of the systems Argon-Oxygen, Argon-Methane, and Argon-Krypton were determined by Veith and Schroder (1937) from melting curves, and of the systems Argon-Oxygen, Argon-Methane, and Argon-Nitrogen by Fedorova (1939) from heat capacity curves.

The solubility of "Argon" [total inert gases in the atmosphere] in sea water as a function of temperature and chlorine content was determined by Rakestraw and Emmel (1938) from 2-28° and 15-21 gms Cl per Kg. of sea water.

The solubility of Argon in olive oil was found to be β=0.15 at 22° by Nasini and Corinaldi (1932) and by Loomis (1946). At 37° β=0.14 (Loomis).

ARGENTUM Ag

SILVER Ag:

THE SOLUBILITY OF SILVER IN MERCURY

(Hudson, 1945)

The author reviews the methods and results of previous investigators and extends the temperature range. Silver and mercury were sealed together in a glass tube which was then suspended in a constant temperature vapor bath for varying periods of time. Knowing the total weight, analyses were made by determining the loss in weight of the solid silver

core after the mercury was removed from it by distillation. Data are also given above the boiling point of mercury, and the solubility up to the melting point of silver has been determined by Murphy (1931). The data below were read from the smooth curve given by the author.

t°	Atomic Percent Ag	t°	Atomic Percent Ag
200	1.80	280	4.20
220	2.33	300	5.01
240	2.86	320	5.88
260	3.45	340	7.14
		356.7	9.29

The distribution of silver between tin and stannous chloride at 910° was studied by Anderson and Ridge (1943). The ratio of silver in the tin to that in the stannous chloride was about four to one.

A theoretical estimation of the distribution ratios of silver between bismuth and bismuth fluoride and between lead and lead fluoride was made by Jellinek (1944).

8.83 mg. of silver dissolve in 100 ml. of a solution which is 0.5% thiourea, 1% H_2SO_4, and 0.06% H_2O_2, in twelve hours. If 1 gm. of iron chloride is substituted for the H_2O_2, at least 10.04 mg silver dissolve. (Plaksin and Kozhuchova 1941).

The equilibrium in the reactions $Ag + CuCl \rightleftharpoons AgCl + Cu$ and $Ag + CuBr \rightleftharpoons AgBr + Cu$ at 1000° was studied by Jellinek and Siewers (1932).

Plaksin and Shabarin (1940) give data for the solubilities of silver-gold alloys in potassium cyanide solutions of various strengths, alone and in the presence of hydrogen peroxide.

Faivre (1940) heated silver oxide and found a maximum solubility of Ag in Ag_2O of 4%.

The system $Ag_4P_2O_7 + 2Pb \rightleftharpoons Pb_2P_2O_7 + 4Ag$ was studied at 1200° by Jellinek and Siewers, 1932.

The systems $2AgI + Pb \rightleftharpoons PbI_2 + 2Ag$ and $2AgCl + Pb \rightleftharpoons PbCl_2 + 2Ag$ were studied at 800° by Hewsky and Jellinek (1933).

SOLUBILITY OF SILVER IN POTASSIUM IODIDE SOLUTION

(Toporescu, 1940)

The author placed silver blocks into a solution containing 50 gms of potassium iodide per 100 gms of solution, and allowed them to stand from 10 to 14 days at room temperature. The silver was then removed and a large volume of water was added to precipitate the silver iodide which had formed.

Days contact	Gms AgI per 10 cc solution	Initial pH	Final pH
10	0.0358	5.8	8.3
12	.0386	5.8	8.8
14	.0522	5.8	10.5

SILVER ARSENATE Ag_3AsO_4 AsO

On the basis of a study of the reaction $Ag_3AsO_4 \rightleftharpoons 3AgCl$ at room temperature ($K = 9.34 \times 10^7$), Tananaev and Lovi (1942) found the solubility product of silver arsenate to be 1.08×10^{-22}

SILVER BROMIDE AgBr Br

Correction: Volume I page 8; Solubility of Silver Bromide in Aqueous Potassium Bromide at 25° (Hellwig, 1900). Line one, Mols KBr per liter, as written. Line two should read: grams AgBr per liter.

SOLUBILITY OF SILVER BROMIDE IN WATER AND NITRIC ACID SOLUTIONS
(Ruka and Willard, 1949)

The authors review and tabulate the results of previous investigators. The solubility was then determined by a radioactive tracer technique, but the precision of the determinations was poor. No change in solubility was detected over a nitric acid concentration range 0.03 -1.0N.

Temp.	Mg. AgBr per liter	
	Pure water	Nitric acid solution
0°	--	0.03
25°	0.4	0.1

SOLUBILITY OF SILVER BROMIDE IN HYDROBROMIC ACID SOLUTIONS
(Erber, 1941)

These data agree with and extend those of Dede and Walther (Vol I, p9)

Results at 0°

Solvent		Saturated solution		
% HBr	Density $d_4^{0°}$	% HBr	%AgBr	Density $d_4^{0°}$
47.8	1.501	46.5	2.68	1.533
40.1	1.389	39.5	1.41	1.404
38.9	1.374	38.5	1.26	1.388
34.8	1.322	34.6	0.77	1.331
26.8	1.230	26.7	.22	1.232
21.1	1.174	21.1	.072	1.175
14.7	1.115	14.7	.018	1.116

Results at 25°

Solvent		Saturated solution		
% HBr	Density $d_4^{25°}$	% HBr	%AgBr	Density $d_4^{25°}$
47.8	1.484	46.4	2.95	1.520
40.1	1.376	39.5	1.58	1.393
38.9	1.360	38.4	1.40	1.375
36.7	1.332	36.3	1.08	1.344
32.2	1.279	32.0	0.59	1.285
26.8	1.221	26.7	.26	1.223
21.1	1.166	21.1	.11	1.167
14.7	1.109	14.7	.030	1.109

SOLUBILITY OF SILVER BROMIDE IN SOLUTIONS OF SODIUM GLYCINATE AT 30°
(DuBois, 1949)

Normality of Sodium Glycinate	1.00	0.50	0.25
Moles AgBr per liter	0.00236	0.00119	0.000595

The reaction of oxygen with silver and silver bromide was studied by Stasiw and Teltow, 1948.

Melting point data for the system AgBr + AgCl + AgI are given by Glistenko and Khromova (1939).

BrO **SILVER BROMATE** $AgBrO_3$

At 5°, 100 gms of a saturated solution in water (d = 0.9998) contain 0.0905 gms $AgBrO_3$.
(Ricci and Aleshnick 1944)

EQUILIBRIUM IN THE SYSTEM SILVER BROMATE - SODIUM BROMATE - WATER
(Ricci and Aleshnick, 1944)

It was found that silver bromate and sodium bromate form two series of solid solutions. Silver bromate dissolves in sodium bromate up to about 3%, and sodium bromate dissolves in silver bromate up to 39.0%, and this limit corresponds to the composition of the double salt $AgBrO_3 \cdot NaBrO_3$. This compound is stable in contact with solutions of varying composition, but forms a continuous solid solution with silver bromate. These facts explain the erratic results of determinations of the solubility of silver bromate when it was prepared by precipitation from sodium bromate solutions. By washing a sample of silver bromate with a large quantity of water, a product of 99.7% purity was obtained. The solubility of this salt at 25° was found to be 0.204±.004%, d=0.9985 ± .0003, which is higher than any previously reported value.

Results at 25°

Gms. $NaBrO_3$ per 100 gms. sat. sol.	Gms. $AgBrO_3$ per 100 gms. sat. sol.	d. of sat. sol.	Gms. $AgBrO_3$ in 100 gms. solid phase by extrapolation	Solid Phase
				$NaBrO_3$
28.26±.02	0.0	1.264±.002		
28.24	...	1.261	0.43	Solid Solution I
28.16	...	1.261	1.7	"
28.08	...	1.260	2.6	"
* 27.97±.02	...	1.260±.001		S.S. I + $AgBrO_3 \cdot NaBrO_3$
27.78	...	1.257	61.23	$AgBrO_3$ $NaBrO_3$
27.05	...	1.248	61.03	"
25.36	...	1.232	61.11	"
22.71	...	1.203	61.16	"
	Average of 10 determinations:		60.95	"
21.28	...	1.185	62.13	Solid Solution II
16.99	...	1.143	63.23	"
13.04	...	1.108	66.60	"
10.28	...	1.079	72.86	"
8.39	...	1.062	78.3	"
7.17	0.01	1.051	84.0	"
3.92	.03	1.025	94.8	"
0.0	.204	.9985		$AgBrO_3$

* Average of 17 determinations

Results at 50°

Gms. $NaBrO_3$ per 100 gms. sat. sol.	Gms. $AgBrO_3$ per 100 gms. sat. sol.	d. of sat. sol.	Gms. $AgBrO_3$ in 100 gms. Solid phase by extrapolation	Solid Phase
35.64	0.0	1.341		$NaBrO_3$
35.25	...	1.333	59.3	S.S. I + $AgBrO_3 \cdot NaBrO_3$
35.21	...	1.335	60.1	"
35.25	...	1.335	60.9	"
35.05	...	1.334	61.09	$AgBrO_3 \cdot NaBrO_3$
34.73	...	1.331	60.88	"
34.57	...	-	61.19	"
28.77	...	1.258	63.29	Solid Solution II
23.32	...	1.196	65.42	"
0.0	0.430	.9934		$AgBrO_3$

SOLUBILITY OF SILVER BROMATE IN POTASSIUM NITRATE AND PYRIDINE SOLUTIONS AT 25°

(Vosburgh and Cogswell, 1943)

Gms. Pyridine per 1000 gms. water	Gms. $AgBrO_3$ per 1000 gms. water	Gms. KNO_3 per 1000 gms. water	Gms. $AgBrO_3$ per 1000 gms. water
0.0	1.950	0.0	1.950
.472	2.311	4.82	2.238
.656	2.433	10.13	2.422
1.007	2.709	40.54	3.075
1.237	2.910		

Gross, Kuzmany, and Wald (1937) give data for the solubility of silver bromate in 79 to 80% iso propyl alcohol solutions containing added salts (silver nitrate, sodium nitrate, sodium benzene sulfonate) at 15°. The solubility of silver bromate in 80% iso propyl alcohol, extrapolated from their results is 0.000125 mols per liter (0.0295 gms. per liter), at 15°.

SOLUBILITY OF SILVER BROMATE IN AQUEOUS SOLUTIONS OF UNSATURATED ALCOHOLS AT 25°

(Keefer, Andrews, and Kepner, 1949)

The ionic strength of the alcohol solutions was adjusted to 0.10 by the addition of KNO_3 prior to the addition of $AgBrO_3$.

Moles Alcohol per liter	Moles Ag^+ per liter	Moles Alcohol per liter	Moles Ag^+ per liter	Moles Alcohol per liter	Moles Ag^+ per liter
Allyl Alcohol		Crotyl Alcohol		Ethylvinylcarbinol	
0.585	2.98	0.702	1.87	0.472	2.68
.293	2.20	.527	1.73	.236	2.04
.146	1.69	.351	1.54	.0944	1.52
.0732	1.38	.176	1.30	.0472	1.28
		.0878	1.16		

Moles Alcohol per liter	Moles Ag^+ per liter	Moles Alcohol per liter	Moles Ag^+ per liter	Moles Alcohol per liter	Moles Ag^+ per liter
Vinylacetic acid ($\mu = 1$)*		Methallyl Alcohol		Methylvinylcarbinol	
0.467	2.90				
.234	2.15	0.470	2.42	0.255	2.12
.117	1.67	.235	1.84	.204	1.93
.0585	1.37	.118	1.48	.102	1.53
0.0	1.01	.059	1.27	.051	1.28
				.025	1.14
*by addition of $HClO_4$		Phenol		2-Methyl-2-buten-1-ol	
		0.488	1.28		
		.224	1.14	0.100	1.21
		.112	1.17	.050	1.12
		0.0	0.989	.020	1.05

SILVER CARBIDE Ag_2C_2 C

SOLUBILITY IN SILVER NITRATE AND SILVER PERCHLORATE SOLUTIONS

(Vestin and Ralf, 1949)

Moles $AgNO_3$ per liter	Millimoles C_2H_2 per 100 ml to cause ppt'n of Ag_2C_2	Moles $AgClO_4$ per liter	Millimoles C_2H_2 per 100 ml to cause ppt'n of Ag_2C_2
0.50	0.04	0.50	1.7
.75	.13	.75	4.6
1.00	.42	1.00	13.4

The solubility of Ag_2C_2 was determined in solutions containing 2 M ClO_4^- ion, made up of x moles $AgClO_4$ and 2 - x moles $NaClO_4$ per liter. The results were as follows at 25°:

Moles Ag^+ per liter	Millimols Ag_2C_2 per liter	Moles Ag^+ per liter	Millimols Ag_2C_2 per liter
0.476	3.33	0.600	8.70
.500	4.10	.640	11.00
.540	5.55	.698	15.2

SILVER ACETATE CH_3COOAg CH

SOLUBILITY OF SILVER ACETATE IN DIOXANE-WATER MIXTURES AT 25°

(Davis and Ricci with Sauter, 1939)

Wt. % Dioxane	Mole % Dioxane	Density of solvent	Gms. Silver Acetate per 1000 cc. sat. sol.	Moles Silver Acetate per 1000 cc. sat. sol.
0	0.0	0.9970	11.122	0.06663
10	2.223	1.0030	8.404	.05035
20	4.667	1.0097	6.073	.03638
30	8.063	1.0189	4.093	.02452
40	12.004	1.0263	2.532	.01517
50	16.987	1.0311	1.4295	.008564
60	23.485	1.0345	0.7050	.004227
70	32.32	1.0372	.2904	.001740
80	45.01	1.0349	.1020	.000611
85	53.68	1.0320	.0476	.000285
90	64.81	1.0295	.0257	.000154
95	79.52	1.0280	.0035	.000021
100	100.0	1.0277	.00000	0.0000000

SOLUBILITY OF SILVER ACETATE IN THE PRESENCE OF OTHER SALTS AT 25°

The data were presented by the author on a molality basis

Added Salt	Gms. Added Salt per 1000 gms. water	Gms. Silver Acetate per 1000 gms. water	Density
Sodium Acetate (MacDougall and Allen, 1942)	0.0	11.140	1.0048
	0.933	10.256	1.0044
	4.056	8.144	1.0044
	7.296	6.692	1.0050
	17.294	4.545	1.0085
	42.81	3.086	1.0196
	58.95	2.784	1.0272
	90.14	2.512	1.0406
Potassium Acetate (MacDougall and Allen, 1942)	1.123	10.241	1.0076
	4.864	8.126	1.0076
	10.089	6.281	1.0083
	19.285	4.667	1.0118
	47.38	3.213	1.0229
	66.25	2.874	1.0319
	98.24	2.629	1.0451
Calcium Acetate (MacDougall and Allen, 1942)	1.757	9.668	1.0091
	9.166	6.565	1.0113
	16.497	5.171	1.0133
	32.54	3.929	1.0186
	76.44	3.115	1.0400
	102.00	3.018	1.0505
	164.18	3.090	1.0776
Strontium Acetate (MacDougall and Allen, 1942)	2.147	9.863	1.0067
	10.393	6.840	1.0100
	21.233	4.974	1.0157
	43.68	3.659	1.0289
	108.01	2.809	1.0643
	149.19	2.731	1.0876
	230.85	2.789	1.1298
Silver Nitrate (MacDougall, 1942)	8.359	8.359	1.0119
	11.999	7.603	1.0142
	16.124	6.855	1.0175
	17.99	6.662	1.0187
	33.81	5.250	1.0304
	34.13	5.233	1.0302
	52.73	4.582	1.0452
Silver Perchlorate (MacDougall, 1942)	10.552	8.206	1.0136
	21.32	6.522	1.0205
	41.39	5.223	1.0352
	62.35	4.882	1.0507
Sodium Perchlorate (MacDougall and Peterson, 1947)	0.0	11.182	--
	419.56	10.282	--

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SOLUBILITY OF SILVER ACETATE IN DIOXANE-WATER MIXTURES AT 25° IN THE PRESENCE OF OTHER SALTS

Added Salt	Moles Added Salt per 1000 ml. Sol.	Gms Added Salt per 1000 ml. Sol.	Mols Silver Acetate per 1000 ml. Sol.	Gms Silver Acetate per 1000 ml. Sol.
Results with 10 wt% Dioxane				
Potassium Nitrate (Davis and Ricci with Sauter, 1939)	0.0	0.0	0.05032	8.399
	.009978	1.0088	.05099	8.511
	.04995	5.050	.05377	8.975
	.1002	10.130	.05619	9.379
	.2001	20.23	.05929	9.897
	.4992	50.47	.06476	10.810
	.9985	100.95	.06959	11.616
Sodium Nitrate (Davis and Ricci with Sauter, 1939)	0.005084	0.4322	0.05081	8.481
	.009924	.8436	.05116	8.540
	.04979	4.233	.05413	9.035
	.09073	7.713	.05585	9.322
	.09996	8.498	.05649	9.429
	.1999	16.993	.05985	9.990
	.4927	41.88	.06583	10.988
	.9979	84.83	.07209	12.033
	1.999	169.9	.07781	12.988
	2.999	254.9	.08034	13.410
	3.172	269.7	.08067	13.465
	4.002	340.2	.08076	13.480
Potassium Chlorate (Davis and Ricci with Sauter, 1939)	0.004987	0.6112	0.05077	8.475
	.01007	1.234	.05127	8.558
	.04995	6.121	.05429	9.062
	.05017	6.148	.05429	9.062
	.09987	12.239	.05695	9.506
	.2018	24.73	.06093	10.170
	.3045	37.32	.06453	10.771
	.4002	49.04	.06637	11.078
Results with 20 wt% Dioxane				
Potassium Chlorate (Davis and Ricci with Sauter, 1939)	0.0	0.0	0.03613	6.031
	.009331	1.1435	.03703	6.181
	.05005	6.134	.04023	6.715
	.09988	12.240	.04275	7.136
	.1506	18.46	.04487	7.490
	.2000	24.51	.04660	7.778
	.2996	36.72	.04913	8.201
Sodium Chlorate (Ricci and Leo, 1941)	0.0	0.0	0.03631	6.061
	.01000	1.065	.03727	6.221
	.05002	5.325	.04055	6.769
	.09991	10.635	.04322	7.214
	.1999	21.28	.04711	7.864
	.4997	53.19	.05438	9.077
	1.050	111.8	.06268	10.463

SOLUBILITY OF SILVER ACETATE IN DIOXANE-WATER MIXTURES AT 25° IN THE PRESENCE OF OTHER SALTS (Con.)

Added Salt	Moles Added Salt per 1000 ml. Sol.	Gms Added Salt per 1000 ml. Sol.	Mols Silver Acetate per 1000 ml. Sol.	Gms Silver Acetate per 1000 ml. Sol.
	Results with 20 wt% Dioxane (Con.)			
Sodium Nitrate (Ricci and Leo, 1941)	0.004984	0.4237	0.03671	6.128
	.04996	4.247	.03996	6.670
	.1024	8.705	.04238	7.074
	.1999	16.99	.04545	7.587
	.2884	24.52	.04751	7.930
	.4998	42.49	.05119	8.545
	.9529	81.01	.05368	8.960
	Results with 30 wt% Dioxane			
Sodium Chlorate (Ricci and Leo, 1941)	0.0	0.0	0.02426	4.049
	.009953	1.059	.02553	4.261
	.05002	5.325	.02878	4.804
	.09952	10.594	.03097	5.170
	.1999	21.28	.03450	5.759
	.5003	53.26	.04189	6.992
	.9980	106.24	.04932	8.232
Sodium Nitrate (Ricci and Leo, 1941)	0.01000	0.8501	0.02483	4.145
	.04994	4.245	.02756	4.600
	.09992	8.494	.03033	5.063
	.2000	17.00	.03303	5.513
	.4998	42.49	.03786	6.320
	1.000	85.01	.04317	7.206
	Results with 50 wt% Dioxane			
Sodium Chlorate (Ricci and Leo, 1941)	0.0	0.0	0.008572	1.4308
	.009952	1.059	.009663	1.6129
	.04992	5.314	.01223	2.041
	.1000	10.65	.01414	2.360
	.1998	21.27	.01703	2.843
	.4996	53.18	.02264	3.779
	.9980	106.24	.02736	4.567
Sodium Nitrate (Ricci and Leo, 1941)	0.005011	0.4260	0.009223	1.5395
	.04999	4.250	.01192	1.990
	.09988	8.491	.01351	2.255
	.2000	17.00	.01569	2.619
	.4998	42.49	.02005	3.347
	.9995	84.97	.02453	4.095

SOLUBILITY OF SILVER ACETATE IN ETHYL ALCOHOL-WATER MIXTURES AT 25° IN THE PRESENCE OF OTHER SALTS

(MacDougall and Allen, 1945)

Results with 10.17 wt. % Ethyl Alcohol

Added Salt	Gms. Added Salt per 1000 gms. water	Gms. Silver Acetate per 1000 gms. water	Density
Sodium Acetate	0.0	8.279	0.9875
	.951	7.461	.9879
	4.125	5.538	.9879
	8.141	4.276	.9884
	16.16	3.183	.9924
	40.45	2.355	1.0040
	54.42	2.222	1.0110
	80.70	2.125	1.0234
Potassium Acetate	1.053	7.540	0.9878
	4.914	5.587	.9882
	9.863	4.215	.9889
	19.66	3.193	.9938
	49.77	2.369	1.0071
	68.51	2.233	1.0157
	84.81	2.182	1.0231
Silver Nitrate	1.721	7.623	0.9891
	8.537	5.665	.9921
	17.87	4.404	.9985
	34.33	3.435	1.0110
	51.05	1.977	1.0242
Silver Perchlorate	2.422	7.445	0.9892
	10.201	5.578	.9937
	19.942	4.362	1.0002
	38.98	3.323	1.0141
	58.91	2.861	1.0297

Results with 20.03 wt. % Ethyl Alcohol

Sodium Acetate	0.0	6.011	0.9716
	.835	5.325	.9707
	4.067	3.662	.9717
	8.253	2.784	.9732
	16.30	2.197	.9768
	41.13	1.683	.9888
	57.35	1.798	.9962
	82.20	1.838	1.0068
Potassium Acetate	1.033	5.340	0.9717
	4.973	3.684	.9724
	10.08	2.774	.9734
	20.60	2.153	.9787
	48.69	1.828	.9918
	68.24	1.808	1.0007
	98.53	1.861	1.0132

CR

Added Salt	Gms. Added Salt per 1000 gms. water	Gms. Silver Acetate per 1000 gms. water	Density
Results with 20.03 wt. % Ethyl Alcohol			
Silver Nitrate	1.748	5.345	0.9718
	8.603	3.719	.9756
	16.82	2.888	.9822
	34.81	2.362	.9957
	50.49	2.235	1.0080
Silver Perchlorate	2.131	5.316	0.9726
	10.815	3.582	.9777
	21.20	2.749	.9853
	41.61	2.123	1.0005
	63.45	1.875	1.0162
Results with 30.01 wt. % Ethyl Alcohol			
Sodium Acetate	0.0	4.382	0.9538
	.857	3.697	.9536
	4.620	2.319	.9547
	8.24	1.880	.9559
	16.92	1.579	.9596
	41.09	1.519	.9708
	54.89	1.571	.9774
	83.60	1.704	.9890
Potassium Acetate	1.026	3.657	0.9523
	5.012	2.367	.9538
	10.25	1.854	.9558
	19.86	1.577	.9606
	49.68	1.523	.9740
	68.64	1.596	.9819
	98.93	1.723	.9941
Silver Nitrate	1.690	3.754	0.9550
	8.491	2.477	.9595
	17.02	1.966	.9658
	33.54	1.653	.9776
	51.00	1.552	.9915
Silver Perchlorate	2.102	3.719	0.9552
	10.981	2.334	.9607
	21.02	1.856	.9680
	41.49	1.539	.9827
	61.66	1.471	.9970

CN **SILVER CYANIDE** AgCN

SOLUBILITY OF SILVER CYANIDE IN HYDROGEN CYANIDE WITH ADDED H_2SO_4 AND HNO_3

(Jander and Grüttner, 1947)

Gms. H_2SO_4 per 1000 cc sol.	Gms. AgCN per 1000 cc sol.	Gms. HNO_3 per 1000 cc sol.	Gms. AgCN per 1000 cc sol.
0.0	0.0	0.0	0.0
9.8	8.0	25.2	2.5
19.6	16.0	63.0	5.5
29.4	24.0	100.8	9.0
39.2	32.5	113.4	11.5
49.0	43.5	126.0	14.5

The above values were read from curves; no temperature given.

Ricci (1947) has made a critical evaluation of the solubility product of Silver Cyanide and the effect of adding various electrolytes to the solution.

CNS **SILVER THIOCYANATE** AgCNS

EQUILIBRIUM IN THE SYSTEM SILVER THIOCYANATE-CALCIUM THIOCYANATE-WATER AT 25°

(McKerrow, Occleshaw, and Drabble, 1946)

Gms. per 100 gms. of sat. sol.			Gms. per 100 gms. of sat. sol.		
AgCNS	$Ca(CNS)_2$	Solid Phase	AgCNS	$Ca(CNS)_2$	Solid Phase
0.0	60.20	α-$Ca(CNS)_2 \cdot 4H_2O$	31.01	25.15	1:2:2 + AgCNS
4.03	58.80	"	30.70	24.52	AgCNS
7.49	57.05	"	22.88	21.72	"
7.52	57.03	α-$Ca(CNS)_2 \cdot 4H_2O$ +	15.42	19.23	"
8.50	55.21	$Ca(CNS)_2 \cdot 2AgCNS$	11.74	17.33	"
8.26	54.74	" $\cdot 2H_2O$	8.09	15.01	"
10.27	50.76	"	3.42	14.11	"
13.09	44.99	"			
14.96	41.95	"		Results at 20°	
19.22	37.02	"	0.0	59.00	α-$Ca(CNS)_2 \cdot 4H_2O$
25.71	29.12	"	4.24	57.27	"
26.74	27.86	"	5.19	56.85	"
29.79	25.47	"	7.50	56.41	"
			8.73	55.44	"

CNSe **SILVER SELENOCYANATE** AgCNSe

Using the cell Ag | AgCNSe, KCNSe | KNO_3 | $AgNO_3$ | Ag Waitkins and McCrosky (1946) determined the solubility product of Silver Selenocyan to be 6.9×10^{-15} at 25 ± .1°.

SILVER CHLORIDE AgCl

SOLUBILITY OF SILVER CHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 0° and 25°

(Erber and Schübly, 1941)

At 25° these results extend the range of observations of Forbes 1911 (p. 36 vol. 1)

0° Gms. Equiv. per liter			25° Gms. Equiv. per liter		
HCl	AgCl	Density	HCl	AgCl	Density
6.48	0.00563	1.1026	6.46	0.00781	1.1033
7.23	.00807	1.1149	6.47	.00811	1.1029
8.78	.01466	1.1393	7.26	.01139	1.1157
10.20	.01949	1.1606	8.76	.01970	1.1397
10.90	.02159	1.1714	10.20	.02727	1.1616
12.06	.02237	1.1909	10.94	.03049	1.1730
12.19	.02169	1.1911	10.75	.02964	1.1726
12.55	.02191	1.1914	12.15	.03091	1.1901
			12.11	.03121	1.1893

SOLUBILITY OF SILVER CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 20°

(Jaques, 1946)

These measurements are from cells of the type $H_2 \mid HCl \mid AgCl \cdot Ag$

Gm. Moles HCl per liter	Gms. AgCl per 1000 gms. solvent	Gm. Moles HCl per liter	Gms. AgCl per 1000 gms. solvent
0.607	0.0036	7.79	1.416
1.274	.0135	9.10	2.233
2.814	.0771	10.52	3.209
3.984	.1899	11.03	3.588
5.30	.440	11.72	4.114
5.83	.588	12.97	5.129

SOLUBILITY OF SILVER CHLORIDE IN AMMONIA SOLUTIONS CONTAINING POTASSIUM NITRATE OR POTASSIUM CHLORIDE AT 25°

(Derr, Stockdale, and Vosburgh, 1941)

Gms. NH_3 per 1000 gms H_2O	Gms. KNO_3 per 1000 gms H_2O	Gms. AgCl per 1000 gms H_2O	Gms. NH_3 per 1000 gms H_2O	Gms. KCl per 1000 gms H_2O	Gms. AgCl per 1000 gms H_2O
1.516	0.0	0.6505			
1.487	5.399	.7467	34.28	0.0	21.66
1.402	10.69	.7458	6.313	.790	2.471
1.526	16.56	.8526	5.952	2.326	1.638
1.502	33.9	.9234	5.089	24.02	0.4240
1.488	61.1	.9701			

Fusion point data are given for the following:

$AgCl - InCl_3$	(Vovkogon and Fialkov, 1945)
$AgCl - PbS$	(Urazov and Sololova, 1941)
$AgCl - Ag_2S - Cu_2S$	(Urazov and Chelidze, 1940)
$AgCl - CuCl - Cu_2S$	(Urazov and Chelidze, 1940)
$AgCl - CdCl_2 - PbCl_2$	(Prokofev and Egorov, 1941)

THE SOLUBILITY OF SILVER CHLORIDE IN UREA AND GLYCINE SOLUTIONS AT 25°

(Dunning and Shutt, 1938)

Determined by electrometric titration

Gms. Urea per 1000 cc sol	Gms. AgCl per 1000 cc sol	Gms. Glycine per 1000 cc sol	Gms. AgCl per 1000 cc sol
0.0	0.00242	0.0	0.00238
63.0	.00331	7.5	.00304
126.1	.00411	15.0	.00333
147.1	.00436	22.5	.00378
180.2	.00456	37.5	.00440
210.2	.00513	52.5	.00476
315.3	.00639	75.1	.00563
427.9	.00753	90.1	.00586
		112.6	.00654

SOLUBILITY OF SILVER CHLORIDE IN SOLUTIONS OF SODIUM GLYCINATE AT 30°

(DuBois, 1949)

Normality of Sodium Glycinate	0.50	0.33	0.25	0.10	0.05
Moles AgCl per liter	0.0199	0.0135	0.0100	0.0038	0.001855

The system $2AgCl + Pb \rightleftharpoons PbCl_2 + 2\,Ag$ was studied at 800° by Hewsky and Jellinek, 1933

Freezing-point data are given for $2AgCl + Cu_2S \rightleftharpoons Ag_2S + Cu_2Cl_2$ (Urazov and Obelidze, 1940)

ClO SILVER CHLORATE $AgClO_3$

SOLUBILITY OF SILVER CHLORATE IN H_2O AND H_2O - D_2O MIXTURES

(Noonan, 1948)

Temp.	Gms. $AgClO_3$ per 100 gms. sat. sol. in H_2O	Gms. $AgClO_3$ per 100 gms. sat. sol. in $H_2O + D_2O$	
5°	7.84_7	5.88_4	(98.38% D_2O)
15°	10.86_8	8.38_8	(98.38% D_2O)
25°	15.28_1	11.50_1	(98.38% D_2O)
35°	19.18_5	15.44_4	(98.18% D_2O)

ClO SILVER PERCHLORATE $AgClO_4$

SOLUBILITY OF SILVER PERCHLORATE IN ORGANIC SOLVENTS AT 25°

(Spurgeon, 1941)

Solvent	Temp.	Density	Gms. $AgClO_4$ per liter sat. sol.	Moles $AgClO_4$ per 1000 gms. solvent
Benzene	25°	0.9139	52.03	0.251
Cyclohexane	25°	.7722	less than 0.01	---
Chlorobenzene	25°	1.104	---	0.00104
Nitrobenzene	25°	1.197	---	0.0372
M-Xylene	5.5°	---	---	0.16
"	15.6°	---	---	0.38
"	25.0°	1.006	---	0.695
"	30.0°	---	---	1.26
"	37.7°	---	---	~ 4.0

CrO

SILVER CHROMATE Ag_2CrO_4

EQUILIBRIUM IN THE SYSTEM SILVER OXIDE - CHROMIC OXIDE - WATER AT 29.9°

(Campbell and Lemaire, 1947)

There are two compounds in the system: Ag_2CrO_4 and $Ag_2Cr_2O_7$, which probably form a pair of solid solutions in each other. The solid solution of Ag_2CrO_4 in $Ag_2Cr_2O_7$ was found to exist up to about 2%, but because of the very small solubility of Ag_2CrO_4 in water, the solubility curve for the solid solution of $Ag_2Cr_2O_7$ in Ag_2CrO_4 could not be found. The conductance of each solution was also determined.

Gms. Ag_2O per 100 gms. sat. sol.	Gms. CrO_3 per 100 gms. sat. sol.	Solid Phase	Gms. Ag_2O per 100 gms. sat. sol.	Gms. CrO_3 per 100 gms. sat. sol.	Solid Phase
Trace	---	Ag_2O +	0.1	4.07	Solid Solution
Trace	---	Ag_2CrO_4	.1	7.11	"
Trace	---	"	.1	8.11	"
Trace	---	"	.1	18.4	"
Trace	---	"	.1	24.0	"
0.09	0.21	Ag_2CrO_4 +	.1	35.1	"
.08	.21	Solid soln.	.1	47.0	"
.11	.19	"	.1	53.6	"
.10	.18	"	.1	58.7	"
.07	.34	Solid Solution	.1	62.0	$Ag_2Cr_2O_7 + CrO_3$
.08	2.55	"	.1	64.9	"

Murgulescu (1941) found the solubility product of silver chromate to be 7.1×10^{-13} using a potentiometric method.

SOLUBILITY OF SILVER CHROMATE IN SALT SOLUTIONS AT 20°

(Sirucek and Viktorin, 1947)

Added Salt		Ag_2CrO_4		Added Salt		Ag_2CrO_4	
Mols per liter of Solvent	Gms. per liter of Solvent	Mols per 1000 gms. Sat. Sol.	Gms. per 1000 gms. Sat. Sol.	Mols per liter of Solvent	Gms. per liter of Solvent	Mols per 1000 gms. Sat. Sol.	Gms. per 1000 gms. Sat. Sol.
KNO_3				$NaNO_3$			
0.0	0.0	0.00009073	0.0301 ± .0002*	0.005	0.43	0.0001033	0.0343
.005	.51	.0001028	.0342	.04	3.40	.0001234	.0409
.04	4.04	.00012425	.0412	.1	8.50	.0001455	.0483
.1	10.11	.0001445	.0479	.16	13.60	.0001562	.0518
.16	16.18	.00015672	.0520	$Mg(NO_3)_2$			
NH_4NO_3				.005	0.74	.0001159	.0385
.005	0.40	.0001115	.0370	.01	1.48	.0001266	.0420
.025	2.00	.0001443	.0479	.02	2.97	.0001405	.0466
.05	4.00	.0001657	.0550	.05	7.42	.0001712	.0568
.1	8.01	.0002028	.0673	$C_6H_5SO_3Na$			
.16	12.81	.0002293	.0761	.02	3.60	.0001163	.0386
				.1	18.02	.0001386	.0460

* Average of 14 determinations

I SILVER IODIDE AgI

SOLUBILITY OF AgI IN AQUEOUS SOLUTIONS OF HI

(Erber, 1941)

The solid phase was AgI throughout

Results at 0°			Results at 25°		
WT.% HI	WT.% AgI	Density $\frac{0}{4}$	WT.% HI	WT.% AgI	Density $\frac{25}{4}$
11.6	0.248	1.096	9.8	0.093	1.075
18.7	2.34	1.192	10.9	0.140	1.084
22.9	6.76	1.304	11.9	0.208	1.092
28.0	21.3	1.647	16.1	0.60	1.127
30.2	29.1	1.888	18.9	1.70	1.177
32.2	33.0	2.066	23.5	5.04	1.271
37.7	37.9	-----	27.2	11.4	1.414
38.0	42.6	2.796	28.7	16.9	1.537
38.4	39.7	2.652	29.3	18.7	1.593
			30.7	22.7	1.695
			31.2	27.5	1.849
			31.7	32.8	2.036
			32.2	33.1	2.055
			32.0	33.5	2.069
			32.6	33.8	2.167
			33.9	41.4	2.515
			34.8	42.9	2.599
			36.0	43.4	2.724
			37.1	43.9	2.794

THE SYSTEM SILVER IODIDE - IODINE - BENZENE AT 6°

(Foote and Fleischer, 1940)

Gms. I_2 per 100 gms. sat. sol.	Gms. I_2 per 100 gms. residue	Solids Present
7.46	0.0	AgI
8.71	12.13	AgI + I_2
8.68	96.62	"

IO SILVER IODATE $AgIO_3$

SOLUBILITY OF SILVER IODATE IN NITRIC ACID SOLUTIONS

(N. C. C. Li and Y. T. Lo, 1941)

Gm. moles HNO_3 per 1000 cc sol.	Gms. $AgIO_3$ per 1000 cc sat. sol.		
	25°	30°	35°
0.0	0.05048	0.06086	0.07316
.001301	.05172	...	...
.006503	.05512	.06711	.08043
.01410	.05854	.07127	.08611
.07050	.07522	.09208	.11091
.1213	.08597	.10605	.12831
.2528	.10803	.13399	.16086
.5050	.14216	.17958	.21826
.8738	.18444		

SOLUBILITY OF SILVER IODATE IN POTASSIUM NITRATE SOLUTIONS AT 25°

(Kolthoff and Lingane, 1938)

The authors found that paraffined bottles were needed. In plain glass bottles the silver ion concentration was always lower than the iodate concentration.

Gms. KNO_3 per 1000 cc sol.	Gms. $AgIO_3$ per 1000 cc sol.	Gms. KNO_3 per 1000 cc sol.	Gms. $AgNO_3$ per 1000 cc sol.	Gms. KNO_3 per 1000 cc sol.	Gms. $AgIO_3$ per 1000 cc sol.
0.0	0.05008	0.6575	0.05413	20.20	0.07537
.1315	.05155	1.426	.05639	50.50	.09372
.3288	.05288	7.128	.06507	100.99	.11555

SOLUBILITY OF SILVER IODATE IN POTASSIUM NITRATE SOLUTIONS

IO

(N. C. C. Li and Y. T. Lo, 1941)

Temp.	Gms. KNO_3 per 1000 cc sat. sol.	Gms. $AgIO_3$ per 1000 cc sat. sol.	Temp.	Gms. KNO_3 per 1000 cc sat. sol.	Gms. $AgIO_3$ per 1000 cc sat. sol.
10°	0.0	0.0274	30°	0.0	0.06086
	.1341	.02833		.1341	.06256
	.3299	.02893		.3299	.06400
	.6535	.02981		.6535	.06572
	1.419	.03122		1.419	.06841
	7.109	.03617		7.109	.08043
				12.26	.08600
20°	0.0	0.04137		25.56	.09694
	.1341	.04265		51.06	.11411
	.3299	.04364			
	.6535	.04474	35°	0.0	0.07316
	1.419	.04683		.1341	.07531
	7.109	.05495		.3299	.07675
				.6535	.07879
25°	0.0	0.05048		1.419	.08258
	.1315	.05167		7.032	.09561
	.3288	.05283		20.25	.11518
	.6575	.05410		50.42	.13583
	1.426	.05662			
	7.128	.06516			
	12.26	.06940			
	25.56	.07899			
	51.06	.09417			
	88.34	.11041			

SOLUBILITY OF SILVER IODATE IN AMMONIA SOLUTIONS AT 25°

(Derr, Stockdale, and Vosburgh, 1941)

Gms. NH_3 per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O	Gms. NH_3 per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O
0.2113	1.036	1.052	5.376
.2158	1.061	1.751	9.115
.3142	1.552	2.127	11.120
.4225	2.101	3.145	16.79
.5254	2.646	4.235	22.98

IO

SOLUBILITY OF SILVER IODATE IN PYRIDINE SOLUTIONS AT 25°

(Vosburgh and Cogswell, 1948)

Gms. Pyridine per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O	Gms. Pyridine per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O
3.93	0.3060	16.30	1.1846
4.33	.3337	23.94	1.773
4.52	.3484	32.4	2.392
7.89	.5894	32.4	2.395
8.01	.6024	40.8	3.015
8.50	.6346	40.8	3.032
11.81	.8736	57.6	4.256
11.85	.8829	67.5	4.983
15.96	1.1801		

SOLUBILITY OF SILVER IODATE IN GLYCINE AND ALANINE SOLUTIONS AT 25°

(Keefer and Reiber, 1941)

Gms. Glycine per 1000 gms H_2O	Gms. $AgIO_3$ per 1000 gm H_2O	Gms. Alanine per 1000 gms H_2O	Gms. $AgIO_3$ per 1000 gm H_2O
0.0	0.05073	2.237	0.05351
1.884	.05257	3.332	.05441
2.829	.05317	5.003	.05659
3.773	.05418	6.733	.05837
5.657	.05574	8.991	.06094
6.181	.05597		
7.563	.05713		
9.294	.05889		
12.42	.06168		
15.33	.06287		

SOLUBILITY OF SILVER IODATE IN AMMONIA SOLUTIONS AT 25°

(Derr, Stockdale and Vosburgh, 1941)

✲ (Vosburgh and McClure, 1943)

With Ammonium Nitrate Added			With Potassium Nitrate Added		
Gms. NH_3 per 1000 gms H_2O	Gms. NH_4NO_3 per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O	Gms. NH_3 per 1000 gms H_2O	Gms. KNO_3 per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O
0.6201	0.79	3.238	0.6163	4.07	3.247
.6129	.82	3.182	.2120	10.09	1.145
.2175	1.60	1.132	.6178	14.40	3.427
.2389	4.03	1.277			
.6156	5.55	3.357			
.2294	10.41	1.285			
.6175	9.93	3.450			
✲ .00215	0.815	0.0636			
✲ .00330	.815	.0676			
✲ .01434	0.0	.0970			
✲ .0698	.401	.3682			
✲ .1401	.817	.732			

SOLUBILITY OF SILVER IODATE IN AMMONIA SOLUTIONS CONTAINING AMMONIUM NITRATE AND NICKEL NITRATE AT 25° 10

(Derr and Vosburgh, 1943)

Gms. NH_3 per 1000 gms. H_2O	Gms. NH_4NO_3 per 1000 gms. H_2O	Gms. $Ni(NO_3)_2$ per 1000 gms. H_2O	Gms. $AgIO_3$ per 1000 gms. H_2O
0.0899	0.929	1.821	0.2279
.1333	.844	1.820	.3323
.1772	.862	1.821	.4516
.2672	.821	1.820	.7101
.3598	.808	1.820	1.030
.3609	.808	1.820	1.042
.3576	.564	1.820	1.016
.7113	.809	3.651	1.562
.5325	.809	1.820	1.684
.7100	.809	1.821	2.422
.7277	.809	1.821	2.495
.9051	.810	1.823	*2.766
1.0984	.878	1.821	4.041
1.211	.885	1.823	4.572
1.643	.861	1.823	6.601
2.183	.926	3.654	7.240
2.182	.837	1.825	9.307

*Solution contained 2.170 gms. KIO_3 per 1000 gm. H_2O in addition.

SILVER MOLYBDATE Ag_2MoO_4 MoO

SOLUBILITY IN WATER

(Ricci and Lifke, 1951)

Temp.	Mg Ag_2MoO_4 per 100 gms. sat. sol.	Temp.	Mg. Ag_2MoO_4 per 100 gms. sat. sol.
10°	2.60	40°	5.19
25°	3.86	45°	5.69
30°	4.16	60°	8.23
35°	4.68	70°	9.74

100 cc of water at 25° dissolve 0.0044 gms. Ag_2MoO_4 (McCay, 1934)

SILVER NITRATE $AgNO_3$ NO

SOLUBILITY OF SILVER NITRATE IN WATER

(Campbell and Boyd, 1943)

The authors used recrystalized silver nitrate and water which had been distilled from alkaline permanganate and baryta with a tin condenser. Silver was determined by electrolytic deposition. From 115° to 145° equilibrium was attained in a glass lined bomb under pressure, and above

145° weighed amounts of water and silver nitrate were sealed together in a glass tube, melted, and cooled until crystallization occurred. Furnace temperatures were measured with a thermocouple to 0.1°.

Temp.	Gms. $AgNO_3$ per 100 gms. sat. sol.	Solid phase	Temp.	Gms. $AgNO_3$ per 100 gms. sat. sol.	Solid phase
-1.89	10.41	Ice	59.99	81.40	α-$AgNO_3$
-3.55	19.72	"	64.92	82.98	"
-5.00	30.04	"	70.61	83.92	"
-6.36	39.16	"	76.02	84.03	"
-7.22	44.72	"	84.42	86.17	"
-7.57	46.9	ice + α-$AgNO_3$	95.43	87.59	"
-6.51	48.13	α-$AgNO_3$	103.57	88.44	"
-0.88	54.04	"	114.25	89.74	"
4.32	58.64	"	124.05	90.42	"
10.41	63.11	"	134.65	92.23	"
NO 15.37	65.90	"	142.0	93.05	"
19.66	68.20	"	146.10	93.52	"
25.18	70.96	"	151.1	94.49	"
30.57	72.81	"	155.0	95.45	"
35.48	74.31	"	160.9	96.45	β-$AgNO_3$
40.07	75.80	"	168.0	97.02	"
44.98	77.47	"	181.1	98.07	"
50.16	78.95	"	194.9	99.06	"
55.29	80.24	"			

0.2 gms. $AgNO_3$ dissolve in 100 gms. of anhydrous HNO_3 (Jander and Wendt, 1948).

The melting points and vapor pressures for the system $AgNO_3$ - NH_4NO_3 - H_2O from the eutectic to the melting points of the salts are given by Dingermans (1943)

Melting points and vapor pressures of the system $AgNO_3$ - NH_4NO_3 - $Pb(NO_3)_2$ - H_2O are given by Dingermans and Dijkgraaf (1947)

Melting point data are given for the following systems:

$AgNO_3 + KNO_3 + NH_4NO_3$ (Bokhovkin, 1946)
$AgNO_3 + NaNO_3 + NH_4NO_3$ (Prokefev, 1941)
$AgNO_3 + BaNO_3 + NaNO_3$ (Kurchenkov, 1941)
$AgNO_3 + KClO_3$ (Drozdov, 1941)
$AgNO_3 + KNO_3 + TlNO_3$ (Palkin, 1949)
$AgNO_3 + NaNO_3 + TlNO_3$ (Palkin, 1949a)
$AgNO_3 + KNO_3 + NaNO_3 + TlNO_3$ (Palkin, 1949b)

Many physical properties of the system $AgNO_3$ - $Pb(NO_3)_2$ - H_2O are given by Nayar and Pande (1948).

O SILVER OXIDE Ag_2O (AgOH)

Näsänen (1943a, 1948) determined the solubility product of silver oxide in solutions of varying ionic strength at 25° by potentiometric titrations. His value at zero ionic strength: $K = 3.9 \times 10^{-8}$ (0.00020 gm. equiv. Ag per liter) agrees well with those of previous workers (Vol. I, p. 70).

Oka (1940) determined the solubility of silver hydroxide in water by potentiometric titration to be 1.2×10^{-4} moles per liter.

Tourky and El Wakkad bubbled nitrogen through silver oxide suspended in water, and found that the particles approached a minimum in size and hence a maximum in solubility. The maximum silver ion activity in the solution was found to be 1.15×10^{-4} gm. moles per liter.

SOLUBILITY OF SILVER OXIDE IN GLYCINE AND SODIUM GLYCINATE SOLUTIONS AT 30° O

(DuBois, 1949)

Normality of glycine	Moles AgOH per liter	Normality of Sodium glycinate	Moles AgOH per liter
1.00	0.0501	0.25	0.0614
0.50	.0389	.10	.0258
.25	.0335	.05	.0128
.10	.0274	.02	.0054

Tananaev and Lovi (1942) found the equilibrium constant of the reaction $Mg(OH)_2 \rightleftharpoons 2\ Ag(OH)$ to be $K = 2.5 \times 10^4$.

Faivre (1940) heated silver oxide and found a maximum solubility of Ag in Ag_2O of 4%.

Markin (1944, 1946) reports the conductivities of the systems $Ag_2O - K_2O - B_2O_3$, and $Ag_2O - Na_2O - B_2O_3$.

SILVER PHOSPHATE Ag_3PO_4 PO

On the basis of a study of the reactions $Ag_3PO_4 \rightleftharpoons 3AgCl$ ($K = 1.25 \times 10^9$) and $MgNH_4PO_4 \rightleftharpoons Ag_3PO_4$ ($K = 1.75 \times 10^8$) at room temperature. Tananaev and Lovi (1942) found the solubility product of silver phosphate to be 1.46×10^{-21}.

SILVER SULFIDE Ag_2S S

Kapustinsky (1940) calculated the solubility product of silver and other metal sulfides in water from free energy data. His value at 25° is 5.9×10^{-52} and agrees reasonably well with those found by other methods. He then calculates the solubility of Ag_2S in solutions of different acidity (25°):

pH	3	5	7	9	11
gm. mols per liter:	1.4×10^{-12}	6.5×10^{-14}	3.8×10^{-15}	6.6×10^{-16}	3.1×10^{-18}

SOLUBILITY OF SILVER SULFIDE AT 20°

(Treadwell and Hepenstrick, 1949a)

pH	1N - $NaClO_4$	1N - $HClO_4$	1M - H_2S	1M - NaOH	Total dissolved Ag^+ gm. atoms per liter
1.0	---	0.100	0.1	---	1.96×10^{-6}
2.0	0.090	.010	.1	---	1.00×10^{-6}
3.00	.099	.001	.1	---	1.17×10^{-6}
4.5	.10	---	.1	0.0005	1.45×10^{-6}
5.65	.10	---	.1	.005	8.14×10^{-6}
6.0	.10	---	.1	.01	11.90×10^{-6}
7.0	.10	---	.1	.02	26.52×10^{-6}

Melting points in the system $Ag_2S - Sb_2S_3$ are given by Jensen, 1947.

SO SILVER SULFATE Ag_2SO_4

SOLUBILITY OF SILVER SULFATE IN PYRIDINE SOLUTIONS AT 25°

(Vosburgh and Cogswell, 1948)

Gms Pyridine per 1000 gms. H_2O	Gms. Ag_2SO_4 per 1000 gms. H_2O
1.167	9.922
1.641	10.380
2.853	11.749
4.344	13.343

SOLUBILITY OF SILVER SULFATE IN DIOXANE-WATER MIXTURES AT 25°

(Davis and Ricci with Sauter, 1939)

Wt. % Dioxane	Mol % Dioxane	Density of solvent	Gms. Ag_2SO_4 per 1000 cc. sat. sol.	Moles Ag_2SO_4 per 1000 cc. sat. sol.
0	0.0	0.9970	8.369	0.02684
10	2.223	1.0030	4.833	.01550
20	4.667	1.0097	2.592	.008314
30	8.063	1.0189	1.252	.004015
40	12.004	1.0263	0.531	.001703
50	16.987	1.0311	.1877	.000602
60	23.485	1.0345	.0561	.000180
70	32.32	1.0372	.0196	.00063
80	45.01	1.0349	.0072	.000023
90	64.81	1.0295	.00196	.0000063
100	100.0	1.0277	.00000	.00000000

SOLUBILITY OF SILVER SULFATE IN AMMONIA SOLUTIONS WITH AMMONIUM SULFATE ADDED AT 25°

(Vosburgh and McClure, 1948)

Gms. NH_3 per 1000 gms. H_2O	Gms. $(NH_4)_2SO_4$ per 1000 gms. H_2O	Gms. Ag_2SO_4 per 1000 gms. H_2O
16.01	3.330	17.680
31.08	3.987	19.420
33.50	3.326	19.763
35.25	3.322	20.062
45.18	3.321	21.098
59.04	3.322	22.557

THE SYSTEM SILVER SULFATE-ALUMINUM SULFATE-H_2O

(Addlestone, Marsh, and Hall, 1940)

Wet residue analyses were made and no evidence of a silver alum was found.

Gms. Ag_2SO_4 per 1000 gms. H_2O	Gms. $Al_2(SO_4)_3$ per 1000 gms. H_2O	Solid Phase	Results at 0° Gms. Ag_2SO_4 per 1000 gms. H_2O	Gms. $Al_2(SO_4)_3$ per 1000 gms. H_2O	Solid Phase
5.52	0.0	Ag_2SO_4	6.58	179.44	Ag_2SO_4
5.58	28.33	"	6.64	203.8	
5.77	57.27	"	6.80	290.4	$Ag_2SO_4 + Al_2(SO_4)_3 \cdot 18H_2O$
6.39	85.74	"			
6.58	112.69	"	0.0	340.0	$Al_2(SO_4)_3 \cdot 18H_2O$

Results at 25°

Gms. Ag_2SO_4 per 1000 gms. H_2O	Gms. $Al_2(SO_4)_3$ per 1000 gms. H_2O	Solid Phase
8.48	0.0	Ag_2SO_4
8.64	37.12	"
9.01	100.8	"
9.04	131.9	"
9.48	175.9	"
9.57	207.6	"
9.64	293.0	"
9.67	358.2	"
9.70	376.0	Ag_2SO_4+$Al_2(SO_4)_3 \cdot 18H_2O$
5.27	382.1	$Al_2(SO_4)_3 \cdot 18H_2O$
0.0	395.8	

Results at 45°

Gms. Ag_2SO_4 per 1000 gms. H_2O	Gms. $Al_2(SO_4)_3$ per 1000 gms. H_2O	Solid Phase
10.38	0.0	Ag_2SO_4
10.94	32.88	"
11.72	65.38	"
12.04	122.7	"
12.38	190.5	"
12.44	252.6	"
12.54	439.3	Ag_2SO_4 + $Al_2(SO_4)_3 \cdot 18H_2O$
0.0	467.0	$Al_2(SO_4)_3 \cdot 18H_2O$

THE SYSTEM SILVER SULFATE-SULFURIC ACID-WATER AT 25°

SO

(Simons and Ricci, 1946a)

Gms. Ag_2SO_4 per 100 gms. sat. sol.	Gms. H_2SO_4 per 100 gms. sat. sol.	Solid Phase
0.833	0.0	H_2SO_4
.990	4.75	"
.946	11.34	"
.618	21.13	"
.411	38.12	"
.400	54.30	"
.632	62.15	"
.831	64.97	"
1.897	70.86	"
2.273	71.87	"
2.84	72.60	"
2.94	72.68	"
3.89	73.66	"
4.06	73.78	"
4.50	74.03	"
4.74	74.26	"
5.50	74.26	"
5.63	74.19	"
6.57	74.21	H_2SO_4 + β $AgHSO_4$
6.55	74.47	"
6.61	74.25	"
6.59	74.31	"
6.52	74.5	"
Av. 6.57	74.35	"
6.18	74.30	H_2SO_4 + β $AgHSO_4$
6.23	74.08	"
6.32	74.31	"
6.32	73.95	"
6.27	74.07	"
Av. 6.26	74.14	"
6.58	74.95	β-$AgHSO_4$
6.54	75.13	"
6.57	75.93	"
7.14	77.9	"
7.97	79.73	"
9.13	80.78	"
9.42	80.92	"
10.85	81.27	"
11.39	81.21	"
12.70	80.89	"
13.58	80.57	"
5.58	75.43	α-$AgHSO_4$
4.94	76.78	"
4.34	80.27	"
4.51	81.59	"
4.79	82.22	"
6.13	82.68	"
7.94	83.01	"
12.81	81.62	"
*19.45	77.86	α or β -$AgHSO_4$(?)
*19.82	77.64	"
*20.81	76.98	"
*21.01	76.41	"
*21.45	76.32	"
*21.50	76.55	"
*21.82	76.17	"

*Solubility curves of α and β -$AgHSO_4$ indistinguishably close.

THE SYSTEM SILVER SULFATE-SODIUM SULFATE-WATER

(Simons and Ricci, 1946)

g_2SO_4 per s. sat. sol.	Gms. Na_2SO_4 per 100 gms. sat. sol.	*Wt. % Ag_2SO_4 in Anhyd. S. S.	Density	Solid Phase
		Results at 20°		
.783	0.0	---	1.004	Ag_2SO_4
.691	0.500	100.2	1.010	Solid Solution
.673	1.044	99.9	1.013	"
.682	2.07	99.8	1.022	"
.704	3.15	99.8	1.032	"
.731	4.19	99.0	1.040	"
.771	5.33	97.9	1.051	"
.836	7.77	97.8	1.075	"
.919	10.72	96.5	1.105	"
.971	12.92	95.4	1.127	"
.015	15.51	95.3	1.154	"
.026	15.92	94.9	1.156	"
.02	16.11		1.163	$Na_2SO_4 \cdot 10H_2O$+s.s.
.025	16.14		1.159	"
.031	16.16		1.161	"
.030	16.12		1.161	"
.03	16.03		1.157	"
.041	16.11		1.161	"
.030	16.11		1.160	"
.066†	16.11		1.161	$Na_2SO_4 \cdot 10H_2O$
.570	16.09		1.157	"
.0	15.89		1.147	"
		Results at 25°		
.833	0.0	---	1.004	Ag_2SO_4
.744	0.507	100.2	1.009	Solid Solution
.722	1.016	99.7	1.013	"
.733	2.07	99.6	1.020	"
.756	3.09	99.2	1.031	"
.786	4.14	98.6	1.040	"
.831	5.42	99.8	1.054	"
.844	5.88	98.7	1.053	"
.893	7.80	98.6	1.073	"
.983	10.63	95.6	1.106	"
.02	12.89	95.6	1.126	"
.079	15.88	93.4	1.159	"
.101	17.40	92.2	1.170	"
.115	18.62	90.7	1.185	"
.121	20.44	90.3	1.202	"
.118	20.83	89.7	1.206	"
.120	21.37	88.4	---	"
.113	21.78	86.8	1.218	"
.111	21.76		1.217	$Na_2SO_4 \cdot 10H_2O$+s.s.
.115	21.78		1.214	"
.113	21.83		1.218	"
.113	21.84		1.218	"
.119	21.80		1.217	"
.114	21.80		1.217	"
.836	21.80		1.214	$Na_2SO_4 \cdot 10H_2O$

Gms. Ag_2SO_4 per 100 gms. sat. sol.	Gms. Na_2SO_4 per 100 gms. sat. sol.	*Wt. % Ag_2SO_4 in Anhyd. S.S.	Density	Sol
		Results at 31.5°		
0.899	0.0	---	1.002	
.814	0.503	99.9	1.009	Soli
.790	1.066	99.9	1.011	
.794	1.548	99.8	1.019	
.813	2.609	99.5	1.029	
.820	2.74	99.1	1.030	
.842	3.615	99.0	1.035	
.887	5.168	98.9	1.049	
1.062	11.40	96.2	1.112	
1.154	15.36	93.6	1.148	
1.181	20.45	88.1	1.203	
1.118	25.18	79.0	1.252	
1.034	27.45	70.3	1.276	
0.919	29.46	62.3	1.297	
.858	30.15	55.0	---	
.772	30.92	46.7	1.304	
.731	31.23	43.2	1.308	
.705	31.35	37.7	1.309	
.656	31.53	36.1	1.313	
.654	31.58		1.311	Na_2SO
.660	31.57		1.317	
.659	31.58		1.315	
.653	31.62		1.314	
Av .656	31.57		1.314	
.588	31.58		1.310	Na_2
.310	31.58		---	
0.0	31.57		1.302	
		Results at 35°		
0.933	0.0	---	1.002	
.836	.57	100.1	1.007	Soli
.827	1.04	100.2	1.011	
.824	1.58	99.4	1.016	
.837	2.04	100.1	1.019	
.877	3.62	99.3	1.034	
.924	5.24	100.2	1.048	
1.01	7.54	97.8	1.073	
1.08	10.35	96.7	1.099	
1.122	12.42	95.0	1.115	
1.184	15.32	93.9	1.153	
1.203	17.23	91.5	1.165	
1.207	22.35	86.5	1.222	
1.092	25.53	77.0	1.257	
1.007	27.86	70.2	1.275	
0.931	29.22	61.8	1.290	
.828	30.24	49.4	1.305	
.699	31.03	---	1.308	
.653	31.42	38.1	1.311	
.597	31.48	28.0	1.312	
.530	31.89	25.8	1.315	
.481	32.13	12.3	1.316	
.316	32.44	1.8	1.318	
0.0	32.99		1.319	

*By algebraic extrapolation

THE TERNARY SYSTEM Ag_2SO_4-$(NH_4)_2SO_4$-H_2O AT 25°

(Simons and Ricci, 1946)

	Gms. Ag_2SO_4 per 100 gms. sat. sol.	Gms. $(NH_4)_2SO_4$ per 100 gms. sat. sol.	Density	Solid Phase
	0.833	0.0	1.004	Ag_2SO_4
	.90	5.95	1.034	"
	1.08	11.88	1.074	"
	1.311	20.58	1.128	"
	1.428	28.93	1.176	"
	1.453	34.48	1.208	"
	1.441	37.75	1.229	"
	1.414	40.67	1.243	"
	1.378	42.92	1.253	Ag_2SO_4 + $(NH_4)_2SO_4$
	1.381	42.87	1.253	"
	1.393	42.91	1.257	"
	1.381	42.94	1.253	"
Av.	1.383	42.91	1.254	"
	0.740	43.18	1.246	$(NH_4)_2SO_4$
	0.0	43.45	1.233	"

SO

THE TERNARY SYSTEM Ag_2SO_4 - K_2SO_4 - H_2O AT 25°

(Simons and Ricci, 1946)

	Gms. Ag_2SO_4 per 100 gms. sat. sol.	Gms. K_2SO_4 per 100 gms. sat. sol.	Density	Solid Phase
	0.833	0.0	1.004	Ag_2SO_4
	0.79	3.86	1.033	"
	.905	7.29	1.067	"
	.991	9.72	1.084	"
	1.009	10.25	1.090	"
	1.03	10.92	---	Ag_2SO_4 + K_2SO_4
	1.04	10.92	1.095	"
	1.04	10.94	1.097	"
	1.04	10.95	1.101	"
	1.032	10.93	1.093	"
	1.04	10.91	1.102	"
	1.04	10.93	1.098	"
Av.	1.04	10.93	1.098	"
	0.885	10.89	1.094	K_2SO_4
	.568	10.82	1.089	"
	0.0	10.80	1.084	"

THE TERNARY SYSTEM Ag_2SO_4 - Li_2SO_4 - H_2O AT 25°

(Simons and Ricci, 1946)

	Gms. Ag_2SO_4 per 100 gms. sat. sol.	Gms. Li_2SO_4 per 100 gms. sat. sol.	Density	Solid Phase
	0.833	0.0	1.004	Ag_2SO_4
	.786	5.57	1.046	"
	.89	11.02	1.102	"
	.95	16.34	1.151	"
	.963	22.04	1.199	"
	.951	25.00	1.227	Ag_2SO_4 + Li_2SO_4
	.954	25.28	1.228	"
	.949	25.35	1.230	"
	.949	25.33	1.230	"
	.949	25.30	1.230	"
	.950	25.34	1.230	"
	.951	25.34	1.233	"
	.952	25.32	1.233	"
Av.	.951	25.32	1.231	"
	.502	25.40	1.223	Li_2SO_4
	0.0	25.53	1.215	"

Se

SILVER SELENIDE Ag_2Se

SOLUBILITY OF SILVER SELENIDE IN AMMONIA
(Yonng and Golledge, 1947)

	Gms. per 100 ml. Solvent		
	23°	34°	64°
Conc. NH_3Aq. (26.3% NH_3 by wt., D. = 0.906)	0.0260	0.0250	---
1:1 NH_3	0.0262	---	0.0240

(Expressed as grams per 100 ml. solvent)

34° and 64° are the respective boiling points of the conc. and 1:1 NH_3 used.

SeO

SILVER SELENATE Ag_2SeO_4

Lehner and Kao (1925) give the solubility of silver selenate as 1.182 gms. per liter of water at 20°.

SOLUBILITY OF SILVER SELENATE IN SOLUTIONS OF SELENIC ACID AT 25°
(Gelbach and King, 1942)

The solubility of Ag_2SeO_4 reported by these authors differs considerably from those of previous workers. They used a salt prepared from recrystallized magnesium selenate hexahydrate and silver nitrate which was analytically pure, and equilibrium was reached from both undersaturation and supersaturation. They calculate the solubility product to be 5.65×10^{-8}.

Molarity of H_2SeO_4	Gms. Ag_2SeO_4 per 1000 cc.	Density
0.0000	0.868	0.99793
.00564	.635	--
.01113	.581	--
.0222	.527	--
.0566	.484	--
.1218	.481	--

Te

SILVER TELLURIDE Ag_2Te

SOLUBILITY OF SILVER TELLURIDE IN AMMONIA
(Yonng and Golledge, 1947)

	Gms. per 100 ml. Solvent		
	23°	34°	64°
Conc. NH_3 (26.3% NH_3 by . ᵀ = 0.906	0.0008	0.00025	---
1:1 NH_3	0.0007	---	0.0020

34° and 64° are the respective boiling points of the conc. and 1:1 NH_3 used.

W

SILVER TUNGSTATE Ag_2WO_4

1 liter of water will dissolve 0.0266 g Ag_2WO_4 (Temperature not given)
(Bucholz, 1940)

SOLUBILITY OF ALUMINUM IN MERCURY

(Klemm and Weiss, 1940a)

Excess aluminum was sealed with mercury in an evacuated quartz tube. mixtures were heated to each temperature for 24 hours, cooled, and the solution analyzed for both aluminum and mercury. Temperatures were ± 2°:

Temperature	Wt. % Al	Atomic % Al
422°	1.01	7.5
435°	1.14	7.9
470°	1.83	12.2
502°	2.20	16.5
537°	5.99	32.2
560°	9.33	43.4
581°	20.61	65.4
595°	39.15	82.7

Fogh (1921) gives the solubility of aluminum in boiling mercury as 0.38%. Smits and DeGrunter (1921) give the solubility at room temperature as 0.002%.

The effect of time of immersion, temperature, and concentration of sodium hydroxide on the rate of dissolution of aluminum was studied by Streicher (1948).

Br **ALUMINUM BROMIDE** $AlBr_3$

THE SOLUBILITY OF ALUMINUM BROMIDE IN n - BUTANE

(Heldman and Thurmond, 1944)

Known amounts of aluminum bromide and n - butane were sealed together in glass tubes, and the temperature at which the aluminum bromide completely dissolved was determined. Corrections were applied for the amount of n - butane which vaporized at each temperature.

Temp.	Mol. Fraction Al_2Br_6	Gms. Al_2Br_6 per 100 gms. sat. sol.	Temp.	Mol. Fraction Al_2Br_6	Gms. Al_2Br_6 per 100 gms. sat. sol.
28.3°	0.0501	32.62	71.1°	0.431	87.42
32.2°	.0609	37.30	71.7°	.465	88.86
38.8°	.0874	46.77	72.7°	.460	88.66
39.2°	.0893	47.36	74.1°	.495	89.99
43.2°	.108	52.63	77.2°	.568	92.34
46.7°	.128	57.39	79.8°	.595	93.09
48.6°	.139	59.70	80.9°	.639	94.20
48.7°	.144	60.69	81.4°	.628	93.93
51.4°	.164	64.29	82.5°	.638	94.18
53.4°	.183	67.27	84.3°	.759	96.65
57.6°	.232	75.87	86.3°	.761	96.69
64.1°	.323	81.41	89.9°	.830	97.81
67.0°	.367	84.18	97.5°	1.000	100.00
67.8°	.387	85.28			

SOLUBILITY OF ALUMINUM BROMIDE IN n - HEXANE

(Boedeker and Oblad, 1947)

Temp.	Mol. Fraction Al_2Br_6	Gms. Al_2Br_6 per 100 gms. sat. sol.	Temp.	Mol. Fraction Al_2Br_6	Gms. Al_2Br_6 per 100 gms. sat. sol.
30.6°	0.068	31.00	60.3°	0.280	70.56
33.1°	.079	34.55	60.5°	.281	70.73
40.5°	.105	41.98	69.8°	.420	81.68
44.1°	.123	46.47	70.3°	.433	82.47
48.5°	.146	51.46	70.7°	.428	82.18
49.9°	.154	53.36	72.6°	.476	84.81
50.0°	.156	53.95	82.4°	.685	92.91
50.6°	.166	55.11	86.6°	.757	95.00
53.9°	.188	58.80	*97.5°	1.000	100.0
55.0°	.209	62.1			

*Miscible in all proportions.

SOLUBILITY OF ALUMINUM BROMIDE IN CYCLOHEXANE Br

(Leighton and Wilkes, 1948)

The method was similar with that used by Heldman and Thurmond for determining the solubility in n - Butane.

Temp.	Mol. Fraction Al_2Br_6	Gms. Al_2Br_6 per 100 gms. sat. sol.	Temp.	Mol. Fraction Al_2Br_6	Gms. Al_2Br_6 per 100 gms. sat. sol.
6.2°	0.0503	25.1	38.7°	0.178	57.9
8.8°	.0568	27.6	39.8°	.183	59.4
17.2°	.0788	35.2	44.5°	.220	64.2
26.4°	.115	45.1	57.0°	.333	76.0
28.5°	.124	47.4	60.3°	.380	79.5
36.0°	.162	55.0	61.7°	.393	80.4
37.6°	.169	56.4	97.5°	1.000	100.0

Melting point data are given for the following:

$AlBr_3$ - KCl (Starckadomskaja, 1939)
$AlBr_3$ - NaCl (Starckadomskaja, 1939)
$AlBr_3$ - CsCl - $C_6H_5NO_2$
$AlBr_3$ - LiCl - $C_6H_5NO_2$
$AlBr_3$ - RbCl - $C_6H_5NO_2$
$AlBr_3$ - RbI - $C_6H_5NO_2$
} (Mezhenni, 1940)

The conductivities, viscosities, and specific gravities at several temperatures have been reported for the following systems:

$AlBr_3$ + NaBr	(Gorenbein and Kriss, 1949)
$AlBr_3$ + KBr	(Gorenbein, 1945) (Gorenbein and Kriss, 1940)
$AlBr_3$ + $SbBr_3$	(Gorenbein, 1945)
$AlBr_3$ + $ZnBr_2$	(Gorenbein, 1945)
$AlBr_3$ + $HgBr_2$	(Gorenbein, 1947)
$AlBr_3$ + NH_4Br	(Gorenbein, 1947)
$AlBr_3$ + CuBr + $C_6H_5CH_3$	(Gorenbein and Ridler, 1941)
$AlBr_3$ + $SbBr_3$ + $C_2H_4Br_2$	(Gorenbein, 1944)
$AlBr_3$ + $SbBr_3$ + $C_6H_5NO_2$	(Gorenbein, 1941)
$AlBr_3$ + KBr + $C_6H_5NO_2$	(Klochko, 1938)
$AlBr_3$ + NaCl + $C_6H_5NO_2$	(Bigich, 1947)

Br Conductivities and other physical chemical data are given for the following:

$AlBr_3$ + Xylene	(Plotnikov and Gitman, 1940)
$AlBr_3$ + $(C_2H_5)_2O$	(Plotnikov and Kaplan, 1948)
$AlBr_3$ + NaI + C_2H_5Br	(Plotnikov and Dumarevska, 1940)
$AlBr_3$ + TlBr + C_6H_6	(Plotnikov and Spektor, 1940)
$AlBr_3$ + IBr	(Fialkov, 1940) (Fialkov and Goldman, 1941)
$AlBr_3$ + ICl	(Fialkov, 1940) (Fialkov and Goldman, 1941)
$AlBr_3$ + IBr + $C_6H_5NO_2$	(Fialkov and Shor, 1949)
$AlBr_3$ + $C_6H_5NO_2$	(Fialkov and Shor, 1949)
Al_2Br_6 · NaBr + $C_6H_5NO_2$	(Bigich, 1948)
Al_2Br_6 · KBr + $C_6H_5NO_2$	(Bigich, 1948a)
Al_2Br_6 · KCl + $C_6H_5NO_2$	(Gorenbein and Burshtein, 1948)

C **ALUMINUM TETRACHLOROPHTHALATE** $Al_2(C_6Cl_4COO)_3$

100 gms. of a saturated solution of the salt in water contains 0.35 gms. at 25° (Lawlor, 1947)

CH **ALUMINUM OXINE** $Al(C_7H_6NO)_3$

The solubility product at room temperature is 5×10^{-33}, and at 18° 20.7 gms. are dissolved in one liter of a saturated solution in chloroform. (LaCroix, 1947)

ALUMINUM CUPFERRATE $Al(C_6H_5N_2O_2)_3$

Pyatnitski (1946) found the solubility product to be 2.3×10^{-19}.

Cl **ALUMINUM CHLORIDE** $AlCl_3$

EQUILIBRIUM IN THE SYSTEM ALUMINUM CHLORIDE-ALUMINUM FLUORIDE-WATER AT 25°
(Ebret and Frere, 1945)

The composition of the double salt was determined by direct analysis and by algebraic extrapolation of the tie lines.

Gms. $AlCl_3$ per 100 gms. sat. sol.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase	Gms. $AlCl_3$ per 100 gms. sat. sol.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase
31.10	0.0	$AlCl_3 \cdot 6H_2O$	28.58	6.90	D.S.
30.48	1.50	"	28.47	6.97	D.S.+$AlF_3 \cdot 3H_2O$
30.37	2.64	$AlCl_3 \cdot 6H_2O$+D.S.	28.45	7.01	"
30.21	3.46	"	24.07	6.30	$AlF_3 \cdot 3H_2O$
30.22	3.46	D.S.	21.04	5.96	"
29.81	4.37	"	14.33	5.52	"
29.47	4.93	"	10.68	4.93	"
28.89	5.62	"	5.50	3.56	"
28.78	6.03	"	0.0	0.41	"
28.72	6.46	"			

D.S. = $AlF_3 \cdot 5AlCl_3 \cdot 38H_2O$

EQUILIBRIA IN THE SYSTEM $AlCl_3$-$FeCl_3$-KCl-HCl-H_2O

(G. L. Miles, 1947)

Gms. per 100 gms. sat. sol.

Temp.	HCl	$FeCl_3$	KCl	$AlCl_3$	NaCl	Solid Phases
25°	26.1	3.90	1.39	3.38	N.D.	$AlCl_3 \cdot 6H_2O$+NaCl+KCl+2KCl·$FeCl_3 \cdot H_2O$
	26.8	4.55	1.31	2.62	N.D.	"
	27.1	2.26	1.77	2.60	0.30	"
	27.9	2.38	1.58	2.51	N.D.	"
	28.0	2.30	1.64	2.38	N.D.	"
	28.4	nil	1.47	2.49	N.D.	$AlCl_3 \cdot 6H_2O$+NaCl+KCl
	31.7	nil	1.38	N.D.	N.D.	"
	32.4	nil	1.42	N.D.	N.D.	"
	36.5	1.33	1.44	0.16	0.11	$AlCl_3 \cdot 6H_2O$+NaCl+KCl+2KCl·$FeCl_3 \cdot H_2O$ Cl
30°	21.3	2.80	2.14	7.45	0.49	"
	21.3	2.82	2.21	7.49	.49	"
	25.9	2.66	1.87	3.92	N.D.	"
	26.0	2.58	1.93	3.65	N.D.	"
	29.0	2.34	1.63	1.70	0.29	"
	29.98	nil	1.65	1.83	0.34	$AlCl_3 \cdot 6H_2O$+NaCl+KCl
	29.92	nil	1.68	1.88	.35	"
	29.9	0.20	1.66	1.91	.36	"
	29.8	.98	1.65	1.52	N.D.	"
	29.1	1.18	1.69	2.02	0.34	"
	29.8	1.74	1.68	1.05	N.D.	"
	28.6	3.60	1.42	1.58	0.28	$AlCl_3 \cdot 6H_2O$+NaCl+2KCl·$FeCl_3 \cdot H_2O$
	28.6	3.84	1.38	1.60	N.D.	"
	28.5	3.99	1.41	1.49	0.28	"
	30.6	2.08	1.51	0.85	.20	$AlCl_3 \cdot 6H_2O$+NaCl+KCl+2KCl·$FeCl_3 \cdot H_2O$
	34.3	1.73	1.50	.32	.18	"
	35.9	1.62	1.52	.25	.14	"
	36.7	1.51	1.55	.20	.13	"
	38.0	1.38	1.62	.18	.13	"
35°	25.7	2.88	2.01	3.61	.42	"
	30.8	2.44	1.74	0.93	.27	"
	32.7	2.23	1.71	.47	.25	"
	36.0	1.93	1.77	.18	.18	"

N. D. = Not Determined

SOLUBILITY OF ALUMINUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 0°

(Seidel and Fischer, 1941)

Gms. HCl per 100 gms. sat. sol.	Gms. $AlCl_3$ per 100 gms. sat. sol.	Density	Gms. HCl per 100 gms. sat. sol.	Gms. $AlCl_3$ per 100 gms. sat. sol.	Density
0	31.0	---	39.0	0.021	1.20
30.8	1.25	1.16	41.7	0.008	1.22
32.3	0.40	1.17	44.2	0.003	1.23
35.4	0.077	1.19	44.3	0.003	1.23
38.7	0.023	1.20			

At 0° 100 cc of a solution saturated with $AlCl_3$ and HCl at 1 atm. pressure contains 0.0015 gms. Al_2O_3.

At 0° 100 cc of a mixture of equal volumes of ethyl ether and water, saturated with $AlCl_3$ and HCl at 1 atm. pressure contains 0.0003 g. Al_2O_3.
- Fischer and Seidel, 1941.

SOLUBILITY OF ALUMINUM CHLORIDE IN BENZENE AND TOLUENE

(Menschutkin, 1909a)

Cl Correction to Vol. I, P. 85 - The results should read:

t°	Solvent	Gms. $AlCl_3$ per 100 gms. sat. sol.	t°	Solvent	Gms. $AlCl_3$ per 100 gms. sat. sol.
17°	C_6H_6	0.12	17°	$C_6H_5CH_3$	0.26
18°	"	0.72	73°	"	0.92

The system $AlCl_3$ - NaCl was studied as follows:

Melting point data	—	(Chretien and Laus, 1943)
Thermal analysis	—	(Shvartsman, 1940)
Vapor pressures	—	(Naryshkin, 1939)
Conductivities	—	(Kryagova, 1939)

-Thermal data in the system $AlCl_3$-KCl are given by Shvartsman.
-Melting points and conductivities for $AlCl_3$-$(C_2H_5)_2O$ are given by Plotnikov and Kaplan, 1948.
-Conductivities (1941), and densities (1942) for the system $AlCl_3$-SO_2 (liquid) are given by Tesei, 1942.
-The system $AlCl_3$-I Cl-$C_6H_5NO_2$ was studied by electrolysis and transference by Fialkov and Kaganckav , 1948.
-Conductivities and specific gravities in the system $AlCl_3$+ICl are given by Fialkov and Shor (1949a).
-The system $AlCl_3$+ICl+$C_6H_5NO_2$ was studied electrically by Fialkov and Kazanekai, 1948.
-The system $AlCl_3+3Na \rightleftharpoons 3NaCl+Al$ was studied at 825° by Jander and Herrman (1938).
-The system $2AlCl_3+3Zn \rightleftharpoons 3ZnCl_2+2Al$ was studied at 550° - 600° by Delimarskii and Berenblyum (1940).
-The system $2AlCl_3+3Ca \rightleftharpoons 3CaCl_2+2Al$ was studied at 800° by Lorenz and Schulz (1928).
-The system $2AlCl_3+3Mg \rightleftharpoons 3MgCl_2+2Al$ was studied at 700° by Lorenz and Schulz (1928).

F **ALUMINUM FLUORIDE AlF_3**

SOLUBILITY OF AlF_3 IN WATER

(Yatlov and Pinaevskaya, 1946)

The authors found 4 hydrates of Aluminum fluoride: $AlF_3 \cdot 3H_2O$ (stable at all temperatures studied), α-$AlF_3 \cdot 3.5H_2O$, β-$AlF_3 \cdot 3.5H_2O$, and $AlF_3 \cdot 9H_2O$. There is a transition between the metastable 9 and β-3.5 hydrates at about 8°. Refractive indices of the solutions are also given.

Temp.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase	Temp.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase
0°	0.25	$AlF_3 \cdot 3H_2O$	0°	2.62	β-$AlF_3 \cdot 3.5H_2O$
10°	.28	"	8°	2.26	"
25°	.50	"	10°	2.31	"
50°	.68	"	25°	2.70	"
75°	.88	"	50°	5.44	"
90°	1.17	"	75°	7.11	"
100°±1°	1.64	"			

(B.P. 745mm)

Temp.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase	Temp.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase
0°	0.56	α-$AlF_3 \cdot 3H_2O$	0°	0.97	$AlF_3 \cdot 9H_2O$
10°	.56	"	5°	1.65	"
25°	.71	"	8°	2.19	"
50°	1.04	"	10°	2.81	"
75°	1.27	"	15°	3.52	"
100°±1° (B.P. 735mm)	1.72	"	25°	5.10	"
			50°	9.45	"

SOLUBILITY OF ALUMINUM FLUORIDE IN WATER F

(Nikolaev, Ivanov, and Koltypin, 1936)

The authors report the solubility of $Al_2F_6 \cdot 5H_2O$.

Temp.	Gms. Al_2F_6 (Anhydrous) per 100 gms. sat. sol.	Density Referred to water at 4°
0°	0.128	1.0018
20°	.499	1.0051
30°	.61	1.0071
50°	.81	1.0078
66°	1.32	--
102°	2.41	--

SOLUBILITY OF $Al_2F_6 \cdot 5H_2O$ IN SOLUTIONS OF HYDROGEN FLUORIDE

(Nilolaev, Ivanov, and Koltypin, 1936)

Temp.	%HF	Gms. AlF_3 (Anhydrous) per 100 gms. sat. sol.	Temp.	%HF	Gms. AlF_3 (Anhydrous) per 100 gms. sat. sol.
18	0.53	0.81	40	5.0	3.0
19	0.68	.85	40	7.7	3.8
18	1.58	.93	40	14.9	4.25
17.5	1.49	.92	40	38	4.9
18.5	3.1	1.19	60	1.0	1.30
20	5.1	2.5	60	3.0	2.2
20	9.9	2.6	60	5.3	3.2
20	14.9	3.2	60	7.9	3.9
20	38.0	4.4	60	15.6	4.4
40	1.0	1.25	60	38	5.0
40	3.0	2.07			

THE TERNARY SYSTEM ALUMINUM FLUORIDE-ALUMINUM NITRATE-WATER AT 25°

(Ebret and Frere, 1945)

Gms. $Al(NO_3)_3$ per 100 gms. sat. sol.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase	Gms. $Al(NO_3)_3$ per 100 gms. sat. sol	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase
39.43	0.0	$Al(NO_3)_3 \cdot 9H_2O$	31.05	5.29	$AlF_3 \cdot 3H_2O$
38.83	1.17	"	24.47	5.20	"
38.53	2.65	"	19.46	5.09	"
38.33	3.95	"	15.20	4.51	"
37.92	5.17	"	10.79	3.99	"
37.92	5.35	$Al(NO_3)_3 \cdot 9H_2O$	5.78	2.78	"
37.88	5.41	$+AlF_3 \cdot 3H_2O$	0.0	0.41	"

THE TERNARY SYSTEM ALUMINUM FLUORIDE-ALUMINUM SULFATE-WATER AT 25°

(Ehret and Frere, 1945)

The composition of the double salt was found by algebraic extrapolation and direct analysis.

Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.	Gms. AlF_3 per 100 gms. sat. sol.	Solid Phase
28.22	0.0	$Al_2(SO_4)_3 \cdot 17H_2O$
28.46	0.68	$Al_2(SO_4)_3 \cdot 17H_2O + Al_2(SO_4)_3 \cdot AlF_3 \cdot 15H_2O$
28.59	.80	"
28.63	.80	$Al_2(SO_4)_3 \cdot AlF_3 \cdot 15H_2O$
26.61	1.18	"
24.85	1.47	"
22.55	1.93	"
20.07	3.05	"
18.95	3.75	"
17.82	4.60	"
17.45	5.33	"
17.12	5.97	$Al_2(SO_4)_3 \cdot AlF_3 \cdot 15H_2O + AlF_3 \cdot 3H_2O$
17.08	5.98	"
14.97	5.51	$AlF_3 \cdot 3H_2O$
10.00	4.46	"
6.18	3.43	"
0.0	0.41	"

F

THE SYSTEM ALUMINUM FLUORIDE-SODIUM FLUORIDE-WATER AT 25°

(Tananaev and Lelchuk, 1942)

The authors claim that cryolite as found in nature or prepared in the laboratory is not $AlF_3 \cdot 3NaF$ but $4AlF_3 \cdot 11NaF$. Both phases were found in the system, the former incongruently soluble and the latter congruently soluble.

Weight %				
Solution		Solid Phase		
NaF	AlF_3	NaF	AlF_3	Solid Phase
0.039	0.303	11.16	8.25	$4AlF_3 \cdot 11NaF$
.038	.149	8.59	6.25	"
.037	.071	15.20	11.20	"
.118	.059	13.70	10.21	"
.178	.0062	14.62	10.61	"
.274	.0021	15.55	11.63	"
.880	.0009	23.73	17.44	"
1.28	.0010	12.17	8.72	"
1.39	--	19.55	13.41	$4AlF_3 \cdot 11NaF + AlF_3 \cdot 3NaF$
2.32	--	15.31	10.31	$AlF_3 \cdot 3NaF$
3.52	--	25.96	17.31	"
3.76	--	25.14	16.64	"

EQUILIBRIUM IN THE SYSTEM ALUMINUM FLUORIDE-SODIUM FLUORIDE-WATER AT 75°

(Yatlov and Pinaevskaya, 1949)

The authors found five stable phases in the system: $AlF_3 \cdot 3H_2O$, solid solutions of $AlF_3 \cdot 3H_2O$ in chiolite, chiolite, solid solutions of chiolite in NaF, and NaF. The chiolite corresponded to the compound $3NaF \cdot 2AlF_3$ which is found in the binary system, instead of the naturally occurring $5NaF \cdot 2AlF_3$. The solid solutions of chiolite in NaF showed no indication of the presence of $11NaF \cdot 4AlF_3$, but the upper solubility limit of the solids had a ratio Na:Al of 2.7 - 2.8.

Saturated Solution		Solid Phase				
% AlF_3	% NaF	% F	% Al	% Na	$\frac{(Na)}{(Al)}$	Identity
0.89	0	40.91	19.85	--	--	$AlF_3 \cdot 3H_2O$
.90	0.038	41.17	19.99	--	--	"
.93	.032	49.81	20.84	10.94	0.63	"
.86	.032	52.78	20.36	15.24	.88	"
.80	.033	---	20.00	15.25	.90	"
.75	.038	56.00	19.67	22.40	1.34	Chiolite
.72	.049	55.60	18.33	24.20	1.55	Cryolite
.50	.046	55.05	18.30	24.65	1.58	Chiolite
.28	.035	55.07	18.27	24.31	1.56	"
.143	.033	55.50	18.10	23.75	1.54	"
.093	.048	55.50	18.36	24.10	1.55	"
.014	.051	54.71	16.72	27.27	1.92	$AlF_3 \cdot 3H_2O$+NaF
.016	.073	53.60	15.82	28.36	2.14	Chiolite
.0105	.060	53.44	14.55	30.32	2.44	$AlF_3 \cdot 3H_2O$+NaF
.006	.082	54.20	13.85	32.40	2.84	Chiolite
~ 0	.40	53.10	14.41	32.62	2.66	"
~ 0	.88	53.40	14.18	32.00	2.66	"
~ 0	1.83	53.30	13.60	32.05	2.70	"
~ 0	2.62	52.82	13.84	31.80	2.69	"
~ 0	3.86	53.66	13.65	32.08	2.75	"
~ 0	4.05	53.02	13,68	32.38	2.78	Cryolite

THE SYSTEM ALUMINUM FLUORIDE-AMMONIUM FLUORIDE-WATER AT 25°

(Novosselova, 1940)

Gms. AlF_3 per 100 gms. sat. sol.	Gms. NH_4F per 100 gms. sat. sol.	Solid Phase
0.55	---	$AlF_3 \cdot 3H_2O$
.46	0.10	"
.57	.13	"
.62	.14	$AlF_3 \cdot 3H_2O$+NH_4AlF_4
.26	.18	NH_4AlF_4
.22	.30	"
.42	.61	NH_4AlF_4+$2NH_4F \cdot AlF_3 \cdot H_2O$
.26	.65	$2NH_4F \cdot AlF_3 \cdot H_2O$
.21	.71	"
.16	.73	"
.17	.82	$2NH_4F \cdot AlF_3 \cdot H_2O$+$(NH_4)_3AlF_6$
.062	1.02	$(NH_4)_3AlF_6$
.022	1.44	"
.012	4.39	"

Freezing-point data for mixtures of AlF_3 with NaF, LiF, KF, CsF, and RbF are given by Dergunov, 1948

The system $AlF_3 + 3Na \rightleftharpoons 3NaF + Al$ was studied at 1090° by Jander and Herrman (1938).

Densities in the systems AlF_3-CaF_3 and AlF_3-NaF-BaF_2 are given by Abramov and Kozunov (1939).

F **ALUMINUM** Fotassium **FLUORIDE** AlK_3F_6

SOLUBILITY OF AlK_3F_6 IN WATER
(Tananaev and Talipov, 1939)

Temp.	Gms. AlK_3F_6 per 1000 gms. sat. sol.
0°	0.8604
25°	1.4288
50°	2.6125
75°	3.4511
100°	4.5828

Melting points in the system AlK_3F_6-$AlNa_3F_6$ are given by Naray-Szabo and Sigmond (1941) and the densities by Abramov, 1939.

ALUMINUM Ammonium **FLUORIDE** $Al(NH_4)_3F_6$

SOLUBILITY OF $Al(NH_4)_3F_6$ IN WATER
(Tananaev and Talipov, 1939)

Temp.	Gms. $Al(NH_4)_3F_6$ per 1000 gms. sat. sol.	Temp.	Gms. $Al(NH_4)_3F_6$ per 1000 gms. sat. sol.
0°	4.3128	60°	11.7034
25°	7.6585	65°	11.2510
50°	12.3622	75°	11.0132
55°	12.1217	100°	7.4190

ALUMINUM Sodium **FLUORIDE** $AlNa_3F_6$

SOLUBILITY OF $AlNa_3F_6$ IN WATER

(Tananaev and Talipov, 1939)

Temp.	Gms. $AlNa_3F_6$ per 1000 gms. sat. sol.
0°	0.3480
25°	.4175
50°	.7932
75°	.9302
100°	1.3500

(Buchwald, 1939)

Temp.	Gms. $AlNa_3F_6$ per liter of. sat. sol.
0°	0.30
18°	.358
25°	.391
37°	.46
95°	.75

NO **ALUMINUM NITRATE** $Al(NO_3)_3$

THE SYSTEM ALUMINUM NITRATE-FERRIC NITRATE-WATER
(Zaslavskij and Ravdine, 1939)

Unlike Malquori (Vol. I, p 91) who found the system to have only the pure hydrated salts as saturating phases at 0°, 25°, and 40°, the authors found a continuous solid solution to exist between the hydrates at 0°, 20°, and 40°. In order to insure equilibrium, the salts were dissolved at higher temperatures, and vigorous shaking was used. Solids were analyzed by the wet residue method, and the densities, indices, and melting points of the mixed crystals were determined.

Solution Wt. %			Wet Residue Wt. %		S. S. Wt. %		Solid Phase	
$Al(NO_3)_3$	$Fe(NO_3)_3$	d.	$Al(NO_3)_3$	$Fe(NO_3)_3$	$Al(NO_3)_3$	$Fe(NO_3)_3$		
			Results at 0°					
37.81	0.0	---	56.6	0.0	56.6	0.0	$Al(NO_3)_3 \cdot 9H_2O$	NO
32.27	4.71	1.362	49.01	5.59	51.40	5.80	Solid Solution	
26.65	9.55	---	42.50	12.88	42.70	13.0	"	
23.46	12.87	1.375	39.90	16.01	40.40	16.0	"	
21.10	15.57	1.378	34.62	19.89	36.0	20.3	"	
17.84	20.42	---	29.78	25.71	30.6	26.1	"	
15.24	23.02	---	26.77	28.26	28.1	28.9	"	
11.60	26.66	1.397	22.65	33.04	23.8	33.6	"	
7.94	30.64	1.405	20.72	36.42	21.0	36.6	"	
4.40	34.08	1.412	10.50	45.70	11.40	47.2	"	
0.0	40.15	---	0.0	59.90	0.0	59.9	$Fe(NO_3)_3 \cdot 9H_2O$	
			Results at 20°					
38.56	0.0		56.6	0.0	56.0	0.0	$Al(NO_3)_3 \cdot 9H_2O$	
33.75	6.26		50.40	6.60	50.4	6.60	Solid Solution	
24.36	15.97		39.76	16.88	40.6	16.70	"	
18.43	23.00		31.60	24.75	33.0	24.88	"	
12.92	28.57		24.37	31.84	25.8	30.30	"	
11.72	10.34		25.16	32.97	25.10	33.0	"	
10.56	31.85		20.17	35.53	22.20	36.2	"	
6.35	37.36		13.71	43.66	14.4	44.4	"	
2.4	40.80		7.99	49.78	5.50	50.6	"	
1.05	42.60		3.79	53.47	4.2	55.2	"	
0.0	45.20		0.0	59.9	0.0	59.9	$Fe(NO_3)_3 \cdot 9H_2O$	
			Results at 40°					
45.25	0.0		56.6	0.0	56.6	0.0	$Al(NO_3)_3 \cdot 9H_2O$	
37.4	8.05		49.86	5.42	51.9	5.00	Solid Solution	
32.74	12.84		48.31	7.77	49.6	7.40	"	
22.13	23.51		38.40	16.89	42.0	15.5	"	
17.55	29.28		32.95	24.81	33.2	24.7	"	
15.04	31.20		28.43	28.15	30.4	27.65	"	
10.63	37.01		24.81	31.82	27.4	30.90	"	
10.1	38.60		23.59	33.96	24.6	33.7	"	
9.13	39.85		22.23	36.33	22.23	36.3	"	
8.31	41.00		19.34	38.80	20.00	38.6	"	
5.32	45.19		10.82	47.69	6.2	48.0	"	
1.42	49.08		6.30	53.25	6.3	53.2	"	
0.0	51.18		0.0	59.9	0.0	59.9	$Fe(NO_3)_3 \cdot 9H_2O$	

Refractive indices for the systems

$Al(NO_3)_3$ - Sodium Acetate - H_2O

$Al(NO_3)_3$ - Sodium Citrate - H_2O

$Al(NO_3)_3$ - Sodium Tartrate - H_2O

are given by Spacu and Popper (1943).

ALUMINUM OXIDE Al_2O_3 O

Oka, 1940 found the solubility of aluminum hydroxide in water to be 5.5×10^{-9} moles per liter by potentiometric titration.

On the basis of experiments which determined the stable solid phase at various temperatures, Laubengayer and Weisz, 1943 present a schematic diagram for the system Al_2O_3-H_2O.

γ $Al_2O_3 . x\ H_2O$ was prepared by Huttig and Markus (1939) and heated to various temperatures for varying periods of time. The solubilities of these preparations in HCL were determined by varying the following factors: amount of starting material, amount of solvent, concentration of solvent, amount, temperature and time of contact.

The $\gamma Al_2O_3 . x\ H_2O$ was also prepared in contact with a number of different gases. The effect of each gas on the $\gamma Al_2O_3 \rightarrow \alpha\ Al_2O_3$ transition was determined by the solubility of the product resulting from each treatment.

SOLUBILITY OF ALUMINUM OXIDE IN BOILING SULFURIC ACID SOLUTION

(Rylands and Jenkinson, 1943)

One gram of pure Al_2O_3 was placed in contact with 100 cc of boiling sulfuric acid solution for 20 minutes. The amount of Al_2O_3 remaining was then determined. The results are read from a curve plotted by the authors.

Gms. H_2SO_4 per 100 gms. solvent	Boiling Point	Gms. Al_2O_3 Dissolved	Gms. H_2SO_4 per 100 gms. solvent	Boiling Point	Gms. Al_2O_3 Dissolved
20	104°	0.04	80	205°	0.54
30	108°	.05	85	232°	.65
40	113°	.07	90	261°	.65
50	124°	.10	95	291°	.58
60	142°	.14	100	338°	---
70	168°	.19			

SOLUBILITY OF ALUMINUM OXIDE - ACID ADDITION COMPOUNDS AT 25°

(Shishniashvili, Kargin, and Batsanadze, 1947)

Determined by conductivity measurements:

$(Al_2O_3H)_2SO_4$	8.6×10^{-5} gm. equiv. per liter
$(Al_2O_3H)H_2PO_4$	7.66×10^{-5} "
$(Al_2O_3H)_2HPO_4$	6.08×10^{-5} "
$(Al_2O_3H)_2SiO_3$	4.9×10^{-5} "
$(Al_2O_3H)Cl$	180 gms. per 100 gms. H_2O

The system Al_2O_3 - SO_2 - H_2O (Fischer and Burger, 1943) was studied by the evaporation of solutions of Al_2O_3 and SO_2 at room temperature in an atmosphere of SO_2. Two compounds $Al_2O_3 \cdot 2SO_2 \cdot xH_2O$ and $Al_2O_3 \cdot 3SO_2 \cdot yH_2O$ were found.

THE SYSTEM Al_2O_3 - $Al_2(SO_4)_3$ - H_2O at 18° (Gromov, 1948):

Gms. Al per 1000 cc sat. sol.	Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.	Density	pH	Solid Phase
				+ $Al_2(SO_4)_3 \cdot 18H_2O$
61.2	25.8	1.266	3.26	$2Al_2O_3 \cdot SO_3 \cdot xH_2O$
38.5	17.9	1.148	3.45	$2Al_2O_3 \cdot SO_2 \cdot xH_2O$
22.9	11.2	1.089	3.65	"
15.9	8.1	1.052	3.71	"
6.4	3.33	1.023	3.84	"
1.7	0.90	1.011	3.98	"
0.64	.34	1.005	4.11	"
.33	.18	1.002	4.20	"
0.00	0.0	1.000	4.43	$Al_2O_3 \cdot xH_2O$

THE SYSTEM Al_2O_3 - CaO - H_2O AT 25°

(See also p101)

(Bessey, 1938; Jones, 1939; Jones, 1944)

The system has been studied by many authors with complex results. Three double salts are reported: $Al_2O_3 \cdot 3CaO \cdot 6H_2O$, $Al_2O_3 \cdot 4CaO \cdot 13H_2O$, $Al_2O_3 \cdot 2CaO \cdot 8H_2O$, and the Al_2O_3 has been both amorphous (gel) and crystalline ($Al_2O_3 \cdot 3H_2O$). The most recent work by Jones (1944) showed that the stable phases in the system were $Ca(OH)_2$, $Al_2O_3 \cdot 3H_2O$ and $Al_2O_3 \cdot 3CaO \cdot 6H_2O$. Data below is from Jones (1939, 1944).

Gms. CaO per 1000 gms. sat.sol.	Gms. Al_2O_3 per 1000 gms. sat.sol.	Solid Phase
0.123	0.014	$Al_2O_3 \cdot 3H_2O$
.119	.017	"
.252	.023	"
.265	.022	$Al_2O_3 \cdot 3H_2O$ + $Al_2O_3 \cdot 3CaO \cdot 6H_2O$
.392	.021	$Al_2O_3 \cdot 3H_2O$ (m)
.485	.019	" (m)
1.08	0.0	$Ca(OH)_2$

m = Metastable

SOLUBILITY OF $Al_2O_3 \cdot 3CaO \cdot 3CaSO_4 \cdot 32H_2O$ IN CaO SOLUTIONS

(Jones, 1939)

Gms. CaO per 1000 gms. sat. sol.	Gms. $Al_2O_3 \cdot 3CaO \cdot 3CaSO_4 \cdot 32H_2O$ per 1000 gms. sat. sol.
0.0365	0.375
.056	.255
.112	.165
.168	.115
.224	.080
.67	.030

The Quaternary system Al_2O_3 - $Al_2(SO_4)_3$ - CaO - $CaSO_4$ - H_2O was studied by Jones 1939, 1944, using first the amorphous and then the crystalline aluminum oxide. The following stable phases were found at 25°: $Al_2O_3 \cdot 3H_2O$, $Ca(OH)_2$, $3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 32H_2O$ (incongruently soluble) $Al_2O_3 \cdot 3CaO \cdot 6H_2O$, and two series of solid solutions of the general composition $xCaO \cdot yAl_2O_3 \cdot zCaSO_4 \cdot aq$. The phase $3CaO \cdot Al_2O_3 \cdot CaSO_4 \cdot 12H_2O$ was found to be the limiting composition of one solid solution. Other possible metastable phases are the compound $Al_2O_3 \cdot 2CaO \cdot 8H_2O$ and another solid solution.

The quinary system CaO - Al_2O_3 - $CaSO_4$ - K_2O - H_2O (1% KOH) at 25° was investigated by Jones (1944a). $3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 32H_2O$ was the only stable quaternary compound found in the system.

The quinary system CaO - Al_2O_3 - $CaSO_4$ - Na_2O - H_2O (1% NaOH) at 25° was investigated by Jones (1944b). The quaternary systems are included, and the results are very similar to the potassium system (above).

A review of the systems involved in portland cement, including the substitution of Fe_2O_3 for Al_2O_3 has been made by Jones (1945).

FO ALUMINUM Ortho PHOSPHATE $AlPO_4$

Ghani and Aleem (1943) shook 10 mg. of $AlPO_4$ with 0.5 N acetic acid, 0.25 N sodium hydroxide, and 2 N sulfuric acid for 2 hours at room temperature and reported the mg. of P_2O_5 found in the volume of solvent used. The figures were recalculated into more convenient form:

Solvent	Mg. P_2O_5 found	Mg. $AlPO_4$ per 100 ml. solution
0.5 N acetic acid	2.8 in 250 ml.	1.9
.25 N NaOH	3.8 in 500 ml.	1.3
2.0 N H_2SO_4	4.40 in 250 ml.	3.0

The solubility of aluminum phosphate in water and in 0.2 N and 1.0 N potassium carbonate solutions, cold and at the boiling point, is given by Devyatin, 1940.

The solubility of aluminum phosphate from various soils in hydrochloric acid and ammonia solutions under varying conditions was determined by Fraps, 1911.

S ALUMINUM SULFIDE Al_2S_3

The system Al_2S_3 - Fe - FeS - Al was studied by x-ray and thermal analysis by Vogel and Hillen, 1942.

SO ALUMINUM SULFATE $Al_2(SO_4)_3$

SOLUBILITY OF ALUMINUM SULFATE IN WATER

(J. L. Henry and G. B. King, 1949)

No attempt was made to identify the hydrated solid phase. The results differ considerably from those of previous workers (Vol. I, p 97). Equilibrium at each temperature was approached from both under- and supersaturation.

Temp.	Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.	Temp.	Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.
25°	28.3	50°	30.6
30°	28.6	55°	31.2
35°	28.9	60°	31.8
40°	29.6	65°	32.9
45°	30.0		

THE SYSTEM ALUMINUM SULFATE - SULFURIC ACID - WATER AT 60°

(J. L. Henry and G. B. King, 1949)

Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.	Gms. H_2SO_4 per 100 gms. sat. sol.	Solid Phase
31.83	0.0	$Al_2(SO_4)_3 \cdot 16H_2O$
29.31	2.37	"
27.87	4.55	"
26.15	7.09	"
23.82	11.03	"
21.88	14.25	"
19.29	19.57	"
16.44	25.93	"
14.59	32.52	"
14.67	35.19 (av.)	$Al_2(SO_4)_3 \cdot 16H_2O + Al_2(SO_4)_3 \cdot 9H_2O$
10.41	39.61	$Al_2(SO_4)_3 \cdot 9H_2O$
7.67	43.95	"
5.99	48.11	"
5.04	50.95	"
4.43	55.09	"
4.09	56.86	"
3.76	58.93 (av.)	$Al_2(SO_4)_3 \cdot 9H_2O$ + 1:3:12
*4.25	60.82	$Al_2(SO_4)_3 \cdot 9H_2O$
0.92	65.61	1:3:12
.63	69.94	"
.63	72.82	"
.99	76.18	"
1.76	78.30 (av.)	1:3:12 + $Al_2(SO_4)_3$
0.17	82.57	$Al_2(SO_4)_3$
.17	86.84	"
.09	90.89	"
Trace	96.08	"

* = Metastable

1:3:12 = $Al_2(SO_4)_3 \cdot 3H_2SO_4 \cdot 12H_2O$

The degree of hydration of aluminum sulfate at 25°, thought by previous workers to be $Al_2(SO_4)_3 \cdot 18H_2O$ has been questioned by Horan and Skarulis (1939), Hill, Smith, and Ricci (1940), and Smith (1942). Horan and Skarulis were unable to prepare the 18-hydrate, and Smith determined several points in three different ternary systems in order to check the composition of the hydrate by the method of algebraic extrapolation. He found the formula to be $Al_2(SO_4)_3 \cdot 17H_2O$.

THE TERNARY SYSTEM $CuSO_4$ - $Al_2(SO_4)_3$ - H_2O AT 25°

(Smith, 1942)

Saturated Solution Wt. %		Original Complex Wt. %		Wt. % $Al_2(SO_4)_3$ in solid by Extrapolation
$CuSO_4$	$Al_2(SO_4)_3$	$CuSO_4$	$Al_2(SO_4)_3$	
0.0	27.85	0.0	--	--
1.281	27.02	0.785	37.06	52.95
2.151	26.37	1.496	34.53	53.17
3.139	26.02	2.049	35.25	52.60
4.464	25.08	3.472	31.29	53.03
5.187	24.65	8	28	(Isothermally invariant point)

THE TERNARY SYSTEM $FeSO_4$ - $Al_2(SO_4)_3$ - H_2O AT 25°

(Smith, 1942)

Saturated Solution Wt. %		Original Complex Wt. %		Wt. % $Al_2(SO_4)_3$ in solid by Extrapolation
$FeSO_4$	$Al_2(SO_4)_3$	$FeSO_4$	$Al_2(SO_4)_3$	
0.0	27.85	0.0	--	--
0.5447	27.33	0.3882	34.64	52.77
1.268	26.96	0.808	36.45	53.12
2.415	26.33	1.579	35.47	52.73
3.198	25.69	1.956	36.27	52.93
3.908	25.28	4.41	26.5	(Isothermally invariant point)

SO

THE TERNARY SYSTEM $NiSO_4$ - $Al_2(SO_4)_3$ - H_2O AT 25°

(Smith, 1942)

Saturated Solution Wt. %		Original Complex Wt. %		Wt. % $Al_2(SO_4)_3$ in solid by Extrapolation
$NiSO_4$	$Al_2(SO_4)_3$	$NiSO_4$	$Al_2(SO_4)_3$	
0.0	27.85	0.0	--	--
0.846	27.09	0.578	35.29	52.98
1.743	26.70	1.043	37.07	52.52
3.982	25.22	2.170	37.68	52.60
6.023	23.74	3.332	36.75	52.86

The average value of the hydrate composition found by Smith is 52.86 % $Al_2(SO_4)_3$ in the solid. This may be compared with the theoretical values:

$Al_2(SO_4)_3 \cdot 16H_2O$ = 54.27 % $Al_2(SO_4)_3$
$Al_2(SO_4)_3 \cdot 17H_2O$ = 52.76 % $Al_2(SO_4)_3$
$Al_2(SO_4)_3 \cdot 18H_2O$ = 51.34 % $Al_2(SO_4)_3$

THE SYSTEM ALUMINUM SUIFATE - LITHIUM SULFATE - WATER AT 0°

(Horan and Skarulis, 1939)

Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.	Gms. Li_2SO_4 per 100 gms. sat. sol.	Solid Phase
0.0	26.50	$Li_2SO_4 \cdot H_2O$
1.90	25.08	"
7.27	21.21	"
10.48	18.19	"
15.17	15.55	"
16.83	14.45	$Li_2SO_4 \cdot H_2O$ + $Al_2(SO_4)_3 \cdot mH_2O$
16.82	14.46	"
17.76	13.07	$Al_2(SO_4)_3 \cdot mH_2O$*
18.17	12.92	"
21.56	7.86	"
23.78	4.64	"
25.74	2.30	"
27.50	0.0	"

*Thought to be $Al_2(SO_4)_3 \cdot 17H_2O$

THE SYSTEM ALUMINUM SULFATE - LITHIUM SULFATE - WATER AT 0°

(Horan and Duane, 1941)

This more recent work than the above, although only in a limited range of concentrations, shows the presence of the double salt (Alum?) $LiAl(SO_4)_2 \cdot 12H_2O$ which is incongruently soluble, and exists only in contact with solutions of a very limited range of compositions.

Saturated Solution Wt. %		Original Complex Wt. %		Wet Residue Wt. %		Solid Phase
$Al_2(SO_4)_3$	Li_2SO_4	$Al_2(SO_4)_3$	Li_2SO_4	$Al_2(SO_4)_3$	Li_2SO_4	
16.66	14.65	17.96	18.98	--	--	*I
16.63	14.59	20.06	17.01	--	--	I
17.23	14.11	22.45	13.68	34.75	12.60	II
17.31	13.94	23.38	13.59	33.82	12.66	II
17.85	13.28	23.96	13.10	37.65	12.47	II
18.05	13.02	22.11	12.52	--	--	III
18.07	13.07	22.62	12.16	--	--	III
18.05	13.08	23.91	11.18	--	--	III

*I = $Li_2SO_4 \cdot H_2O$ + $LiAl(SO_4)_2 \cdot 12H_2O$

II = $LiAl(SO_4)_2 \cdot 12H_2O$ (Photographs of crystals shown)

III = $LiAl(SO_4)_2 \cdot 12H_2O$ + $Al_2(SO_4)_3 \cdot mH_2O$ (m not determined)

SO

SOLUBILITY OF ALUMINUM SULFATE IN BOILING SULFURIC ACID SOLUTIONS

(Rylands and Jenkinson, 1948)

The values were read from a graph given by the authors.

Gms. H_2SO_4 per 100 gms. solvent	Boiling Point	Gms. $Al_2(SO_4)_3$ per 100 cc solvent
70	168°	235
75	185°	180
80	205°	120
85	232°	60
90	261°	0

THE SYSTEM ALUMINUM SULFATE - THALLIUM SULFATE - WATER AT 25°

(Hill, Smith, and Ricci, 1940)

Gms. Tl_2SO_4 per 100 gms. sat. sol.	Gms. $Al_2(SO_4)_3$ per 100 gms. sat. sol.	Solid Phase
0.0	27.83 us	$Al_2(SO_4)_3 \cdot mH_2O$*
.118	27.63	$Al_2(SO_4)_3 \cdot mH_2O$ + Tl Alum
.114	27.64	"
.391	20.37	Tl Alum
1.341	9.82	"
3.502	3.343	"
4.743	2.460	"
5.774	2.044	Tl Alum + Tl_2SO_4
5.764	2.040	"
5.590	1.294	Tl_2SO_4
5.208 (u)	0.0	"
5.218 (s)	0.0	"

* Thought to be $Al_2(SO_4)_3 \cdot 17H_2O$

u = From undersaturation

s = From supersaturation

THE SYSTEM ALUMINUM SULFATE - ETHANOL - WATER

(B. A. Gee, 1945)

Results at 30°

Wt. % $Al_2(SO_4)_3$ in solution	Wt. % C_2H_5OH in solution	Density	Solid Phase
0.1	99.8	0.781	$Al_2(SO_4)_3$
.1	96.0	.790	"
.1	95.1	.791	$Al_2(SO_4)_3 + Al_2(SO_4)_3 \cdot 10H_2O$
.0	92.6	.800	"
.0	90.8	.804	"
.0	83.5	.824	"
.0	77.5	.841	"
.0	70.1	.861	"
.0	69.1	.863	"
.0	67.8	.867	"
.0	66.4	.870	$+ Al_2(SO_4)_3 \cdot 16H_2O$ $Al_2(SO_4)_3 \cdot 10H_2O$
.0	64.0	.878	$Al_2(SO_4)_3 \cdot 16H_2O$
.1	62.4	.881	"
.2	59.4	.882	"
.2	58.8	.892	"
.3	56.8	.898	"
.4	53.5	.908	"
.7	51.8	.913	"
1.0	49.9	.919	"
1.4	46.0	.924	"
2.8	40.9	.935	"
(Two layers) 3.8	38.1	.947	(Top layer) "
(Two layers) 11.4	26.1	1.038	(Bottom layer) "
(Two layers) 6.9	33.0	0.957	(Top layer) "
(Two layers) 15.3	20.0	.990	(Bottom layer) "
19.5	15.5	1.162	"
20.3	13.0	1.186	"
22.5	8.1	1.223	"
26.6	2.0	1.293	"
27.7	0.0	1.302	"

Results at 80°

Wt. % $Al_2(SO_4)_3$ in solution	Wt. % C_2H_5OH in solution	Density	Solid Phase
0.9	98.9	0.745	$Al_2(SO_4)_3$
.7	92.0	.759	"
.3	86.3	.776	"
.1	83.0	.783	"
.0	80.0	.790	$Al_2(SO_4)_3 + Al_2(SO_4)_3 \cdot 10H_2O$
Double layer { 2.0	63.5	.840 (Top)	"
Double layer { 38.0	6.9	1.345 (Bottom)	"
" { 1.9	62.1	0.848 (Top)	"
" { 36.4	7.2	1.320 (Bottom)	"
" { 2.0	60.8	0.854 (Top)	"
" { 32.8	9.1	1.285 (Bottom)	"
" { 2.0	60.5	0.856 (Top)	"
" { 32.9	9.0	1.280 (Bottom)	"
" { 3.0	56.5	0.860 (Top)	"
" { 32.2	9.3	1.230 (Bottom)	"
" { 3.4	52.4	0.871 (Top)	"
" { 29.4	11.5	1.210 (Bottom)	"
" { 4.5	50.0	0.903 (Top)	"
" { 28.5	11.5	1.200 (Bottom)	"
" { 5.5	43.7	0.912 (Top)	"
" { 27.2	12.8	1.152 (Bottom)	"
" { 6.6	44.0	0.918 (Top)	"
" { 25.0	14.0	1.143 (Bottom)	"
" { 8.4	38.8	0.964 (Top)	"
" { 23.2	15.5	1.132 (Bottom)	"
24.0	15.3	1.131	"
17.5	22.0	1.042	"
12.3	31.0	0.990	"
39.4	3.5	---	"
42.2	0.0	---	"

THE SOLUBILITY OF AMMONIUM AND POTASSIUM ALUM IN WATER

(Schlain, Prater, and Ravitz, 1947)

The authors approached equilibrium from both undersaturation and supersaturation and temperature control was ± 0.1°. The authors plotted their data on graphs, and read the values below from the smoothed curves. The data differ from those of previous investigators which have been summarized on p. 101, vol. I. However, the densities agree well with those of Barkeley (Trans. Roy. Sol. 203A, 214, '04) up to 60°.

Temp.	Ammonium Alum			Potassium Alum		
	Gms. per 1000 gms. sat. sol.	Mols. per 1000 gms. sat. sol.	Density	Gms. per 1000 gms. sat. sol.	Mols. per 1000 gms. sat. sol.	Density
0°	53.6	0.0592	1.0258	54.5	0.0575	1.0283
10°	73.4	.0810	1.0347	76.0	.0802	1.0392
20°	102	.113	1.0464	103	.109	1.0519
25°	120	.132	1.0521	120	.127	1.0586
35°	156	.172	1.0705	161	.170	1.0808
45°	216	.238	1.0958	224	.236	1.111
55°	296	.327	1.130	309	.326	1.155
65°	391	.432	1.179	408	.430	1.215
75°	514	.567	1.241	541	.571	1.297
85°	692	.764	1.331	738	.778	1.444

Ammonium Alum = $(NH_4)_2Al_2(SO_4)_2 \cdot 24H_2O$ Potassium Alum = $K_2Al_2(SO_4)_2 \cdot 24H_2O$

EQUILIBRIUM IN THE SYSTEM ALUMINUM THALLIUM SULFATE - ALUMINUM AMMONIUM SULFATE - WATER AT 25°

(Hill, Smith, and Ricci, 1940)

Sat. Sol. Wt. %		Solid Wt. %		Solid Phase
SO $TlAl(SO_4)_2$	$NH_4Al(SO_4)_2$	$TlAl(SO_4)_2$	$NH_4Al(SO_4)_2$	
6.988	0.0	66.20	0.0	$TlAl(SO_4)_2 \cdot 12H_2O$
6.045	7.23	62.53	2.992	Solid Solution
4.558	2.039	55.71	8.42	"
3.387	3.107	45.62	16.31	"
2.387	4.004	36.27	23.24	"
1.536	4.780	24.74	32.72	"
0.689	5.563	14.17	41.34	"
0.0	6.15	0.0	52.31	$NH_4Al(SO_4)_2 \cdot 12H_2O$

EQUILIBRIUM IN THE SYSTEM ALUMINUM THALIUM SULFATE - ALUMINUM POTASSIUM SULFATE - WATER AT 25°

(Hill, Smith, and Ricci, 1940)

Sat. Sol. Wt. %		Solid Wt. %		Solid Phase
$TlAl(SO_4)_2$	$KAl(SO_4)_2$	$TlAl(SO_4)_2$	$KAl(SO_4)_2$	
6.989	0.0		0.0	$TlAl(SO_4)_2 \cdot 12H_2O$
4.202	2.519	51.43	11.97	Solid Solution
2.606	4.020	37.28	23.56	"
1.321	5.280	21.42	36.73	"
0.403	6.17	7.035	48.28	"
0.0	6.59	0.0		$AlK(SO_4)_2 \cdot 12H_2O$

Part of the quaternary system $AlK(SO_4)_2$-$NH_4Fe(SO_4)_2$-H_2O was studied by Hill, Smith, and Ricci, 1940 and showed a continuous series of solid solutions.

The following systems have been studied by Collet (1949) at 20°

System		Solid Phases Present
Ternary	$Al_2(SO_4)_3$-Na_2SO_4-H_2O	$Al_2(SO_4)_3 \cdot 18H_2O$, $Al_2(SO_4)_3 \cdot Na_2SO_4 \cdot 24H_2O$, $Na_2SO_4 \cdot 10H_2O$
	$Al_2(SO_4)_3$-$Al_2(SeO_4)_3$-H_2O	$Al_2(SeO_4)_3 \cdot 22H_2O$, $Al_2(SO_4)_3 \cdot 18H_2O$
Quaternary - $Al_2(SO_4)_3$-Na_2SeO_4-H_2O		$Al_2(SO_4)_3 \cdot 18H_2O$, $Al_2(SeO_4)_3 \cdot 22H_2O$, mixed crystals of $Na_2SO_4 \cdot 10H_2O$+$Na_2SeO_4 \cdot 10H_2O$, $Al_2(SO_4)_3 \cdot Na_2SO_4 \cdot 24H_2O$, $Al_2(SeO_4)_3 \cdot Na_2SeO_4 \cdot 22H_2O$

SeO **ALUMINUM SELENATE** $Al_2(SeO_4)_3$

Collet (1949) studied the system $Al_2(SeO_4)_3 + Na_2SeO_4 + H_2O$ at 20° and found the solid phases: $Al_2(SeO_4)_3 \cdot 22H_2O$, $Al_2(SeO_4)_3 \cdot Na_2SO_4 \cdot 22H_2O$, $Na_2SO_4 + H_2O$. No data are given, but approximate concentrations may be read from the diagram for the quaternary system $Al_2(SeO_4)_3 + Na_2SO_4 + H_2O$.

ARSENIC As

Equilibria in the following systems have been determined:

As + Ag (Owen and Rowlands, 1940)
As + Cr (Haraldsen and Nygaard, 1939)
As + Cu (Owen and Rowlands, 1940)
As + Ge (Stohr and Klemm, 1940)
As + Si (Klemm and Pirscher, 1941)
As + Cu + Ni (Koster and Mulfinger, 1940)

ARSENIC Tri BROMIDE $AsBr_3$ Br

SOLUBILITY IN NITROBENZENE

(Bernstein, 1941)

The author studied the system by thermal and conductimetric methods. The following data were read from the melting point curves given in the paper.

Temp.	Mole % $AsBr_3$	Solid Phase	Temp.	Mole % $AsBr_3$	Solid Phase
5°	1	$C_6H_5NO_2$	5°	59	$AsBr_3$
0°	10	"	10°	67	"
-5°	19	"	15°	74	"
-10°	26	"	20°	80	"
-16°	39	$C_6H_5NO_2$ + $AsBr_3$	25°	87	"
-10°	44	$AsBr_3$	30°	96	"
-5°	48	"			
0°	52	"			

Melting points in the system $AsBr_3$ + trinitrotoluene are given by Pushin, Nikolic, et al (1947), and for $AsBr_3$ + azobenzene by Pushin (1948a).

ARSENIC Tri CHLORIDE Cl

Fusion data for the following systems have been determined:

$AsCl_3$ + CCl_4
$AsCl_3$ + $SiCl_4$
$AsCl_3$ + $GeCl_4$
$AsCl_3$ + $SnCl_4$
} (Sisler, Pfahler, and Wilson, 1948)

$AsCl_3$ + Diphenylamine
$AsCl_3$ + o, m, p-Toluidine
$AsCl_3$ + Adamsite
} (Pushin and Hrustanovic, 1948)

$AsCl_3$ + Trinitrotoluene (Pushin, Nikolic, et al 1947)

$AsCl_3$ + $C_6H_5NH_2$
$AsCl_3$ + $CH_3C_6H_4NH_2$
$AsCl_3$ + $(CH_3)_2C_6H_3NH_2$
} (Pushin, 1948a)

H ARSINE AsH_3

SOLUBILITY OF ARSINE IN WATER

(Soubeiran, 1830; Strohmeyer; Wolff, 1936; Gebert, 1937; Jung, 1939)

Soubeiran reported the solubility to be 5 volumes of AsH_3 per volume of H_2O, but did not give the method used nor the purity of the gas. Strohmeyer found $\beta = 0.018$, but the small solubility was probably due to a large amount of hydrogen mixed with the arsine. Wolff liquified his arsine using a mixture of solid carbon dioxide + alcohol, and then distilled it three times at low temperatures. At 20° Wolff found $\beta = 0.195$. Gebert repeated Wolff's experiments, and concluded that Wolff, along with previous workers, was dealing with a mixture of arsine + hydrogen. Gebert liquified the gas with solid carbon dioxide + alcohol and distilled it twice at reduced pressure, using liquid air to cool the receiver. Foreign gases were removed from the solid by pumping at reduced pressure. His value at 20° is $\beta = 0.282$ and is the highest reported. Jung solidified the gas with liquid air, pumped off foreign gases with a high vacuum pump, and stored the arsine as a solid until used. He determined the solubility as a function of temperature, and his data were plotted and the values given below were read from the smoothed curve. Jung attributes the disagreement between his data and Wolff's and Gebert's to poor temperature control on the part of the other authors, and to some small errors due to their method.

Temp.	β
0°	0.42
5°	.34
10°	.30
15°	.26
20°	.23
25°	.20

- The solubility in 0.9 % NaCl solution at 20° is $\beta = 0.286$
- The solubility in water decreases as the solution is made acidic (HCl, H_3PO_4), or basic (NaOH).
- The solubility in solutions containing blood serum or egg albumin is about the same as the solubility in water.
- The solubility was determined in hematin solutions and suspensions of red blood cells in 0.9% NaCl.
- The mechanism of the arsine oxidation in biological solutions is discussed in detail.

– Gebert, 1937.

The solubility is correlated with the amount of methemoglobin in solution by Wolff (1936), who also studied the mechanism of arsine oxidation.

Data for the solubility of arsine in water, blood, serums, physiological salt solutions, ether, chloroform, and some salt solutions are given by Meissner (1913).

SOLUBILITY OF ARSINE IN VARIOUS SOLUTIONS
(Jung, 1939)

% NaCl	Temp.°	Bunsen Coeff. β	% NaOH	Temp.°	Bunsen Coeff. β
0.0	22	0.228	2	20	0.163
.45	22	.221	4	21.5	.149
2.95	22	.178	4	20	.145
3.9	22	.163	8	21.5	.080
9.5	22	.119	20	21.5	.020
17.6	22	.069			
			% H_2SO_4		
% $Na_2S_2O_4$					
			1.2	21.7	.223
1.9	21	.206	6.5	21.5	.173
3.8	20.5	.192			
			% Glycochol		
% NaOH					
			0	22.5	.211
0.0	19	.262	1	22.5	.187
.4	21	.216	2	22.5	.175
.8	21	.179	4	22	.137
.8	20.5	.180	10	22	.113
2	21.5	.163			

Jung (1939) gives the solubility of arsine in cattle and pig's blood under varying conditions of time, added materials, dilution, etc., and also summarizes the results of other authors.

ARSENIC Tri IODIDE AsI_3 I

Melting point data are given for:

AsI_3 + I (no compounds) Montignie, 1941
AsI_3 + Naphthalene
AsI_3 + Phenanthrene > Pushin, 1948a

ARSENIC TRIOXIDE As_2O_3 O

Margulis (1947), and Margulis and Gane (1947) extracted As_2O_3 with water and found that their results could be explained on the existence of two forms of As_2O_3 existing in the sample. The amount extracted depended upon the number of previous extractions and the amount of solid at the start.

SOLUBILITY IN WATER AT 25°
(Garrett, Holmes, and Laube, 1940)

The As_2O_3 was recrystallized and washed with conductivity water many times. An average of eight determinations showed the solubility to be 0.1035 ± .008 mols. per 1000 gms. water (2.047 gms. per 1000 gms. water). Three determinations using a recrystallized and sublimed product the same value. These results agree well with those of other investigations.

SOLUBILITY OF ARSENIC TriOXIDE IN HYDROCHLORIC ACID SOLUTIONS AT 25°
(Garrett, Holmes, and Laube, 1940)

Gms. HCl per 1000 gms. H_2O	Gms. As_2O_3 per 1000 gms. H_2O	Gms. HCl per 1000 gms. H_2O	Gms. As_2O_3 per 1000 gms. H_2O
0.0	2.047	75.86	1.622
1.466	1.986	94.82	1.614
2.991	1.988	105.8	1.592
3.756	1.998	115.6	1.468
11.09	1.962	125.8	1.525
25.64	1.879	136.8	1.563
36.47	1.812	158.6	1.822
37.75	1.818	178.7	1.939
55.62	1.672	295.4	9.79

O

SOLUBILITY OF ARSENIC TriOXIDE IN SODIUM HYDROXIDE SOLUTIONS AT 25°
(Garrett, Holmes, and Laube, 1940)

Gms. NaOH per 1000 gms. H_2O	Gms. As_2O_3 per 1000 gms. H_2O	Gms. NaOH per 1000 gms. H_2O	Gms. As_2O_3 per 1000 gms. H_2O
0.0	2.047	28.1	12.89
1.200	2.447	36.09	15.92
2.801	3.050	40.09	17.88
4.013	3.466	60.06	23.9
8.002	5.10	80.42	32.2
12.00	6.63	120.0	41.5
20.13	11.33	240.0	83.9

S **ARSENIC Tri SULFIDE** As_2S_3

Montignie (1941a) heated the following mixtures to about 300° and examined the residue for possible reaction products:

$As_2S_3 + MgO$
$As_2S_3 + Bi_2O_3$
$As_2S_3 + HgO$
$As_2S_3 + PbO$
$As_2S_3 + MoO_3$
$As_2S_3 + HgS$

Au **GOLD** Au

Tronev and Bondin (1937) determined the rate of solubility of powdered gold in potassium cyanide solutions under varying conditions of temperature and pressure. Increased nitrogen pressure over the solution had practically no effect, but the velocity of solution at 18° increased with increased pressures of air up to 50 atmospheres, and then became constant. (In one hour, 100 cc of 1% KCN solution dissolved 41% of a 1 gm. sample of gold) Under these conditions 225 mg. oxygen were dissolved in 100 cc of solution. At 50° the optimum pressure was not attained. At 50 atm. pressure the rate of solution increased steadily with temperature.

The effect of ozone and oxygen on the solubility of gold in cyanide solutions has been studied by Plaksin and Sinelnikova, 1939.

Plaksin and Shabarin (1940) give data for the solubilities of gold-silver and gold-copper alloys in solutions of potassium cyanide of various concentration, alone and in the presence of hydrogen peroxide.

SOLUBILITY OF GOLD IN THIOUREA SOLUTIONS
(Flaksin and Kozhuchova, 1941)

100 cc of each solution was used. P = Powder G = Granular L = Leaf

Solution Composition	Time in Hours	Mg. Au at Start	Mg. Au in Solution
0.5% Thiourea	6	10.09 (P)	0.0
" + 1% H_2SO_4	6	10.50 (P)	0.3
" + 0.06% H_2O_2	6	10.20 (P)	0.32
" + 1% H_2SO_4 + 0.06% H_2O_2	6	10.12 (P)	10.12
" + " "	48	10.12 (G)	4.53
" " "	48	10.00 (L)	1.60
0.3% Thiourea " "	10	9.80 (L)	0.40
1% Thiourea " "	48	9.70 (L)	1.87
2% Thiourea " "	48	10.12 (L)	2.80
0.5% Thiourea " "	6	11.13 (L)	0.95
" + 1% HCl "	6	5.86 (L)	0.60
" + 1% HNO_3 "	6	5.48 (L)	0.45
" + 1% NaOH "	6	11.18 (L)	0.02
" + 0.1% $Ca(OH)_2$ "	6	10.68 (L)	0.16
" + 0.5% H_2SO_4 + 0.03% H_2O_2	14	10.23 (G)	4.13
" + 1% H_2SO_4 "	14	10.12 (G)	4.30
" + 2% H_2SO_4 "	14	10.22 (G)	4.05

Tetra Ethyl Saccharato Di GOLD $(C_2H_5)_2AuO_2C(CHOH)_4CO_2Au(C_2H_5)_2$ CH

The compound is 0.2% soluble in water at room temperature. (Gibson and Weller, 1941).

AIR AIR

SOLUBILITY OF AIR IN WATER

Determinations of the solubility of air in water have been made by Bunsen (1855), Dittmar (1884), Winkler (1901, 1904, 1921) and Rakestraw and Emmel (1937). Bunsen's values are 15-20% smaller, and Dittmar's values 2-5% larger than the results given below, which are those of Winkler (1904, 1921). Winkler's earlier values (1901) differ slightly from these.

Temp.	β	Volume % O_2 in dissolved gas	Temp.	β	Volume % O_2 in dissolved gas
0°	0.02918	34.91	22°	0.01801	33.95
5°	.02568	34.69	*22°	.0179	---
10°	.02284	34.47	25°	.01708	33.82
15°	.02055	34.25	30°	.01564	33.60
20°	.01868	34.03			

*Rakestraw and Emmel (1937).

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SOLUBILITY OF AIR IN SULFURIC ACID SOLUTIONS

(Bohr, 1910; Tower, 1906)

The results are in cc of air (measured at 0°, 760mm) dissolved in 1 cc of solution.

Bohr					Tower		
Temp.	Gm. Equivalents H_2SO_4 per liter of Solution	cc N_2	cc O_2	Total		Moles H_2SO_4 per 1000 gms. H_2O	cc Air
20.9°	0	0.0156	0.0310	0.0466		10.0	0.0162
20.9°	4.9	.0091	.0195	.0286		15.0	.0100
20.9°	8.9	.0072	.0155	.0227	18°	25.0	.00644
21.2°	10.7	.0066	.0143	.0209		40.0	.00526
21.1°	20.3	.0049	.0119	.0168		92.0	.00555
21.5°	24.8	.0048	.0103	.0151		500.0	.0072
20.8°	29.6	.0051	.0117	.0168			
20.9°	34.3	.0100	.0201	.0301			
21.1°	35.8	.0129	.0275	.0404			

Christhoff (1906) found the solubility of air in 95.6% H_2SO_4 (d = 1.839) at 20° to be 0.01703 cc (measured at 20°, 760 mm) per cc of solution.

Kobe and Kenton (1938) determined the solubility of air, alone and mixed with carbon dioxide, in a solution of $Na_2SO_4 + H_2SO_4$. See note on page 89. The data are found on page 95.

The solubility of air in liquid chlorine at 1-7 atm pressure is:

Temp.°	β
-30	0.30
- 2	.32
+30	.37

(Roessler and Hasslacher)

SOLUBILITY OF AIR IN SEA WATER

Fox (1909) gives equations for the solubility of oxygen and nitrogen in sea water with varying temperatures (0° - 28°) and Cl content (0° - 20 parts of Cl per 1000 parts H_2O).

Dittmar (1884) studied the composition of ocean waters throughout the world, at the surface and at various depths. He reports the average solubility of air in sea water to be as follows:

Temp.	β	Vol. % O_2 in Dissolved Gas
0°	0.02378	34.40
5°	.02108	34.24
10°	.01892	34.09
15°	.01717	33.93
20°	.01572	33.78
25°	.01449	33.62
30°	.01344	33.47
35°	.01253	33.31

For further data on the solubility of air in liquids see pp. 364, 365.

For data on the solubility of air in acetone, see page 587.

Data are given for the solubility of air in:

CH_3OH, C_2H_5OH, $(C_2H_5)_2O$, $CHCl_3$, $C_2H_5NO_2$, C_6H_6 - (Angstrom, 1888).
C_2H_5OH, C_6H_6, Kerosens, Turpentine, Oil of Lavender - (Robinet, 1864).
C_6H_6 - (Dolezalek, 1910).
C_2H_5Cl dissolves about three times as much air as does water (at 11°) - (Jenkins and Shorthose).

SOLUBILITY OF AIR IN ETHYL ETHER
(Christoff, 1912)

Temp.	β
0	0.290
10	.277
15	.271

The solubility of air in blood was determined by VanSlyke and Neil (1924)

SOLUBILITY OF AIR IN FATS AND OILS
(Schaffer and Haller, 1948(1)) (Schmidt-Nielsen, 1927(2)) (Van Slyke, 1939(3))

β = cc of air (measured at 0°, 760 mm) dissolved in 1 cc of oil.
β' = cc of air (measured at 0°, 760 mm) dissolved in 1 gm. of oil.

	Oil or Fat	Temp.°	β	β'	Vol. % O_2 in dissolved gas
1	Butter Oil	40	1.01	-	---
1	"	60	0.96	-	---
1	Lard	40	.88	-	---
1	Cottonseed Oil	40	.87	-	---
3	Olive Oil	19	.0759	-	
2	"	20		.50	28.7
2	"	50		.61	15.7
2	Cottonseed Oil	20		0.50	32.4
2	"	50		.64	16.2
2	Linseed Oil	20		1.01	19.1
2	"	50		1.04	10.0
2	Corn Oil	20		0.47	29.6
2	"	50		.64	11.6
2	Mineral (Transformer) Oil	20		.84	30.6
2	"	50		.81	30.5
2	Cod Liver Oil	20		.96	21.8
2	"	50		.90	23.5
2	Herring Oil	20		.59	10.8
2	"	50		.57	---

For further data on the solubility of air in oils, see Vernon, 1907.

BORON B

B

No compounds are found in the system Boron + Boron Tribromide (Cueilleron, 1944).

BORON Tri BROMIDE BBr_3

Br

FUSION POINTS IN THE SYSTEM BORON TRIBROMIDE - BROMINE
(Cueilleron, 1944)
(Selected Data)

Temp.°	Gms. BBr_3 per 100 gms. mixture	Solid Phase	Temp.°	Gms. BBr_3 per 100 gms. mixture	Solid Phase
- 5.7	0.0	Br_2	-60.1	80.0	$Br_2 + BBr_3$
-17.1	25.0	"	-53.0	91.0	BBr_3
-38.9	60.5	"	-47.5	100.0	"

C1 BORON Tri CHLORIDE BCl_3

FREEZING POINTS IN THE SYSTEM BORON TRICHLORIDE - SULFUR DIOXIDE

(Martin, 1945)

Sulfur Dioxide is practically insoluble in Boron Trichloride, and Boron Trichloride is soluble in Sulfur Dioxide up to 9.9 mol. %.

Mol. % BCl_3	Freezing Points°		Mol. % BCl_3	Freezing Points°	
	BCl_3 in SO_2	SO_2 in BCl_3		BCl_3 in SO_2	SO_2 in BCl_3
0.0	-76.0	---	49.3	-78.0	---
2.1	-76.8	---	59.8	-78.2	107.3
3.8	-77.1	---	70.5	-78.0	106.7
9.9	-78.0	---	79.7	-78.1	108.3
19.8	-78.0	---	93.8	-78.2	---
29.6	-78.0	---	100.0	---	108.3
40.1	-78.1	-108.1			

FREEZING POINTS IN THE SYSTEM BORON TRICHLORIDE - PHOSGENE

(Martin and Faust, 1949)

(Selected Data)

Mole % BCl_3	Temp.	Solid Phase	Mole % BCl_3	Temp.	Solid Phase
0.0	-132.5°	$COCl_2$	45.8	-128.0°	BCl_3
12.2	-135.0°	"	75.3	-115.0°	"
25.6	-142.3°	$COCl_2 + BCl_3$	100.0	-107.3°	"

FREEZING POINTS IN THE SYSTEM BORON TRICHLORIDE - HYDROGEN SULFIDE

(Martin, 1945)

This system is similar to the system BF_3 - H_2S. It contains A 1:1 compound whose melting point is -35.3° and is stable over a large range of concentrations. The curve is quite flat at the maximum.

(Selected Data)

Mol. % BCl_3	Temp. °C	Solid Phase	Mol. % BCl_3	Temp °C	Solid Phase
0.0	-85.4	H_2S	50.0	-35.3	BCl_3 - H_2S
2.0	-93.9	$H_2S + BCl_3 \cdot H_2S$	80.0	-44.4	"
9.7	-48.1	$BCl_3 \cdot H_2S$	99.9	-108.8	$BCl_3 \cdot H_2S + BCl_3$
25.2	-41.2	"	100.0	-107.9	BCl_3

FREEZING POINTS IN THE SYSTEMS BORON TRICHLORIDE - METHYL CHLORIDE AND BORON TRICHLORIDE - ETHYL CHLORIDE

(Martin and Hicks, 1946)

(Selected Data)

With Methyl Chloride

Mol. % BCl_3	Temp. °C	Solid Phase
0.0	-97.1	CH_3Cl
29.8	-112.5	"
51.8	-125.1	$CH_3Cl + BCl_3$
75.5	-115.0	BCl_3
100.0	-107.6	"

With Ethyl Chloride

Mol. % BCl_3	Temp. °C	Solid Phase
0.0	-138.2	$C_2H_5Cl \quad 2BCl_3$
14.3	-143.9	$C_2H_5Cl + C_2H_5Cl \cdot$
40.0	-121.2	$C_2H_5Cl \cdot 2BCl_3$
55.0	-116.6	"
66.7	-115.8	" $+BCl_3$
72.8	-116.3	$C_2H_5Cl \cdot 2BCl_3$
100.0	-107.2	BCl_3

FREEZING POINTS IN THE SYSTEMS BORON TRICHLORIDE - PROPYL CHLORIDE AND BORON TRICHLORIDE - ISOPROPYL CHLORIDE

(Martin and Humphry, 1947)

(Selected Data) C1

With Propyl Chloride			With Isopropyl Chloride		
Mol. % BCl_3	Temp. °C	Solid Phase	Mol. % BCl_3	Temp. °C	Solid Phase
0.0	-122.3	C_3H_7Cl	0.0	-117.7	$i-C_3H_7Cl$
25.1	-131.9	"	6.4	-118.5	$i-C_3H_7Cl$ + 3:1
42.4	-141.8	$C_3H_7Cl + BCl_3$	19.7	-107.3	3:1
64.5	-120.5	BCl_3	25.0	-105.0	"
100.0	-107.0	"	34.6	-106.0	"
			59.6	-111.9	"
			70.7	-114.7	$3:1 + BCl_3$
			89.9	-109.4	BCl_3
			100.0	-107.2	"

3:1 = $(i-C_3H_7Cl)_3 \cdot BCl_3$

BORON Tri FLUORIDE BF_3 F

SOLUBILITY IN n - PENTANE

(Cade, Dunn, and Hepp, 1946)

Values read from curves given by the authors. Solubilities are expressed in cc of BF_3 (at 0°C, 1 atm pressure BF_3) per gram of normal Pentane. At constant partial pressure of BF_3, the solubility in n - Pentane is a minimum at about 70°.

Total Pressures in atmospheres	49°	66°	93°
4.0	1.6	0.8	---
6.0	3.4	2.3	0.6
8.0	5.0	3.7	2.1
10.0	6.7	5.3	3.8
12.0	8.9	7.0	5.8
14.0	11.7	9.0	---

FREEZING POINTS IN SYSTEMS OF BORON TRIFLUORIDE

(Booth and Martin, 1942)

(Selected Data)

With Methyl Chloride			With Hydrogen Chloride		
Mol. % BF_3	Temp. °C	Solid Phase	Mol. % BF_3	Temp. °C	Solid Phase
0.0	- 96.7	CH_3Cl	0.0	-113.1	HCl
41.2	-116.8	"	9.8	-120.2	"
65.5	-144.8	$CH_3Cl + BF_3$	20.3	-124.1	"
83.3	-134.0	BF_3	37.8	-126.9	"
100.0	-126.7	"	60.0	-141.2	"
			72.3	-134.2	$HCl + BF_3$
			89.7	-130.5	BF_3
			100.0	-127.0	"

With Nitrous Oxide			With Sulfur Dioxide		
Mol. % BF_3	Temp. °C	Solid Phase	Mol. % BF_3	Temp. °C	Solid Phase
0.0	- 91.1	N_2O	0.0	- 73.5	SO_2
40.0	-109.8	"	22.3	- 84.7	"
76.6	-138.0	$N_2O + BF_3$	38.0	- 97.2	$SO_2 + SO_2 \cdot BF_3$
87.1	-132.3	BF_3	50.0	- 96.0	$SO_2 \cdot BF_3$
100.0	-126.8	"	79.8	-106.8	"
			95.2	-128.6	$SO_2 \cdot BF_3 + BF_3$
			100.0	-126.8	BF_3

F

Booth and Walkup, 1943 report the freezing points of the following mixtures:

$BF_3 + CF_2Cl_2$ (Practically completely immiscible)

$BF_3 + CF_3Cl$ (Partially miscible at freezing points, liquids miscible at higher temperatures).

$BF_3 + CF_4$ (Partially miscible at freezing points, liquids miscible at boiling points).

$BF_3 + PF_3$ (Eutectic at 21.5 mol. %, -163.5°, no evidence of compound formation).

$BF_3 + POF_3$ (Evidence is found for the compound $F_3PO \cdot BF_3$, M.P. about -20°).

$BF_3 + PSF_3$ (Eutectic at 16.0 mol. %, - 151.2°, no compounds formed).

$BF_3 + SOF_2$ (1:1 compound is formed, M.P. -140.8°).

FREEZING POINTS IN THE SYSTEM BORON TRIFLUORIDE - PHOSGENE

(Martin and Faust, 1949)

(Selected Data)

Mol. % BF_3	Temp.°	Solid Phase	Mol. % BF_3	Temp.°	Solid Phase
0.0	-132.5	$COCl_2$	50.0	-134.3	1:1 (F.P.)
15.3	-138.0	"	60.4	-142.3	1:1 + BF_3
23.2	-143.0	$COCl_2$ + 2:1	80.7	-133.0	BF_3
33.3	-137.0	2:1 (F.P.)	100.0	-127.6	"
38.4	-138.0	2:1 + 1:1			

2:1 = $2COCl_2 \cdot BF_3$ 1:1 = $COCl_2 \cdot BF_3$ F.P. = Freezing point of compound.

O **BORON OXIDE, BORIC ANHYDRIDE B_2O_3**

SOLUBILITY OF BORIC ANHYDRIDE IN NITRIC ACID SOLUTIONS AT 30°

(Trombe, 1942)

The author draws a diagram of the system B_2O_3 - HNO_3 - H_2O at 30°, but does not give any numerical data. The solubility decreases slowly to a minimum of 0.6% at 30% HNO_3, and then remains practically constant at 0.95% up to 60% HNO_3, whence it increases fairly rapidly to a maximum of 25%. At this point the solution has the composition $B_2O_3 \cdot H_2O \cdot x\ HNO_3$ (about 91% HNO_3). The solubility then decreases up to 100% HNO_3.

The following systems have been investigated:

B_2O_3 + PbO (McMurdie, 1941) (4 compounds: 1:4, 1;2, 4:5, 2:1).
" (Shartsis, Spinner, and Smock, 1948) (Surface tensions).
B_2O_3 + MgO (Toropov and Konovalov, 1940) (3 compounds: 1:1, 2:1, 3:1) (and also M. A. Knight, 1942).
B_2O_3 + ZnO + SiO_2 (Ingerson, Morey, and Tuttle, 1948).
B_2O_3 + BeO + Li_2O (Mazelev, 1940) and (Menzel and Sliwinsi, 1942).
B_2O_3 + BaO (Levin and MacMurdie, 1949).

BORON OXIDE HYDRATE, BORIC ACID H_3BO_3

See also p 215 OH

SOLUBILITY OF BORIC ACID IN WATER
(Blasdale and Slansky, 1939)

t°	Gms. H_3BO_3 per 100 gms. Sat. Sol.	t°	Gms. H_3BO_3 per 100 gms. Sat. Sol.	t°	Gms. H_3BO_3 per 100 gms. Sat. Sol.
0	2.70	40	8.17	75	17.40
5	3.14	45	9.32	80	19.06
10	3.52	50	10.23	85	21.01
15	4.17	55	11.54	90	23.27
20	4.65	60	12.96	95	25.22
25	5.43	65	14.42	100	27.53
30	6.34	70	15.75	*103.3	29.27
35	7.19				

*Boiling point

SOLUBILITY IN WATER
(Penrath, 1942)

Temp.	Gms. H_3BO_3 per 100 gms. sat. sol.	Temp.	Gms. H_3BO_3 per 100 gms. sat. sol.
110°	31.0	160°	63.4
120°	35.2	166°	70.6
126°	39.2	172°	77.6
138°	45.7	176°	85.0
141°	47.9	179°	92.0
145°	49.4	181°	100.0 *
152°	56.5		

* Melts incongruently

SOLUBILITY OF BORIC ACID IN 50% SULFURIC ACID SOLUTION

(Batuner, 1938)

Temp.	Gms. H_3BO_3 per 100 gms. sat. sol.	Gms. H_2SO_4 per 100 gms. sat. sol.
35°	1.68	50
45°	2.30	50
55°	2.74	50
65°	3.38	50

A solution saturated with H_3BO_3 and $MgSO_4 \cdot H_2O$ and containing 50% H_2SO_4 has the following composition:

OH

Temp.	Gms. H_3BO_3 per 100 gms. sat. sol.	Gms. $MgSO_4$ per 100 gms. sat. sol.	Gms. H_2SO_4 per 100 gms. sat. sol.
35°	2.02	3.75	50
45°	2.33	3.75	50
55°	2.86	3.75	50
65°	3.71	3.75	50

Data for the system H_3BO_3 + NaCl + H_2O at -20°, -10°, 10°, 20° and 25° is given by Falkin and Goloshchapov (1939). The eutectic occurs at -21.4° and the saturated solution contains 22.9% NaCl and 1.45% H_3BO_3.

SOLUBILITY AND PARTITION COEFFICIENTS OF BORIC ACID IN ETHER - WATER MIXTURES

(Bachelet, Cheylan, and LeBris, 1947)

0.073 gms. dissolve in 100 gms. Anhydrous Ether at 12°.
0.1 " " " " " of Ether saturated with water at 14°.
0.16 " " " " " " " containing 7.2 gms. $UO_2(NO_3)_2 \cdot 6H_2O$ at 16°.
0.14 " " " " " " " " 6.6 " " 18°.

Partition Coefficients

10 cc of water, containing the listed amounts of boric acid were shaken with 100 cc of ether saturated with water.

Temp.	Gms. H_3BO_3	Partition Coefficient
12°	0.36	0.035
14°	0.2	0.024
14°	0.072	0.025
14°	0.072	0.028
15°	0.34	0.038

0.05 gms. H_3BO_3 are contained in 100 gms. of a saturated solution in furfural at 25° (Trimble, 1941).

Melting point data are given for the following systems:

H_3BO_3 + Glucose	(No compounds)	Mehta and Kantak (1946)
H_3BO_3 + Galatose	(")	
H_3BO_3 + Tartaric Acid	(")	
H_3BO_3 + Resacetophenone	(4:1 compound)	Neelakantam, Narayanan, and Sitaraman (1947).
H_3BO_3 + Gallacetophenone	(4:1 ")	
H_3BO_3 + Resorcylic Aldehyde	(3:1 ")	
H_3BO_3 + 2 Acetyl-1 Naphthol	(3:1 ")	

Ba **BARIUM** Ba

The binary systems Ba + $BaCl_2$ and Ba + $BaBr_2$ have been investigated by Cubicciotti and Thurmond (1949). The results show limited solid solutions between the metal and its salts.

AsO **BARIUM ARSENATES** $Ba_3(AsO_4)_2$, $BaHAsO_4$, $BaH_4(AsO_4)_2$, $Ba(H_3As_2O_7)_2$

EQUILIBRIUM IN THE SYSTEM BARIUM OXIDE - ARSENIC PENTOXIDE - WATER AT 17°
(Guerin, 1938)

This system was first studied by Hendricks (J. phys. chem. 30, 248-53, (1926); (Vol. I, p. 130)) at 30°. He reported the existence of these compounds: $3BaO{\cdot}As_2O_5{\cdot}xH_2O$ ($Ba_3(AsO_4)_2{\cdot}xH_2O$), $2BaO{\cdot}As_2O_5{\cdot}3H_2O$ ($BaHAsO_4{\cdot}H_2O$), and $BaO{\cdot}As_2O_5{\cdot}4H_2O$ ($BaH_4(AsO_4)_2{\cdot}2H_2O$). The solid phases were identified by wet residue analysis and microscopic examination, but the analytical results presented do not justify assigning the formula $BaO{\cdot}As_2O_5{\cdot}4H_2O$ to the third solid.

Guerin reports five compounds: $3BaO{\cdot}As_2O_5{\cdot}xH_2O$, $2BaO{\cdot}As_2O_5{\cdot}3H_2O$, $BaO{\cdot}As_2O_5{\cdot}3H_2O$ ($BaH_4(AsO_4)_2{\cdot}H_2O$), $BaO{\cdot}As_2O_5{\cdot}2H_2O$ ($BaH_4(AsO_4)_2$), and $BaO{\cdot}2As_2O_5{\cdot}3H_2O$ ($Ba(As_2O_7H_3)_2$). Thus he agrees on the existence of the 3:1:x and 2:1:3 compounds, finds the 1:1 compound in two hydrated forms (·3 + ·2), but not the hydrate found by Hendricks (·4), and finds a new compound 1:2:3. The compositions of the compounds found by Guerin were fixed by wet residue analyses on many mixtures, and the tie lines converge sharply in all cases. Equilibrium was approached from undersaturation by prolonged agitation.

The results of the two authors on the solubilities of the 3:1:x and 2:1:3 compounds agree moderately well in solutions containing less than 20% As_2O_5 by weight, as do the listed compositions of the isothermal invariant point involving hydrated As_2O_5.

In Guerin's work, the compound 1:1:3 was found to be wholly metastable with respect to the compound 1:2:3. The invariant point 1:1:3 + 1:1:2 + solution coincides with that of the stable 1:1:3 + 1:2:3 + solution and the slope of the 1:1:2 solubility curve differs but slightly from that of the 1:1:3 compound. It is therefore possible that the solubility curve of the 1:1:2 compound is merely the approximate metastable extension of the solubility curve of the 1:1:3, and that the apparent extrapolation of the tie lines to the composition 1:1:2 is coincidental and caused by lack of equilibrium along the curve, evaporation of water during sampling of wet residues, etc.

Data of Guerin, 1938

Gms. As_2O_5 per 100 gms. sat. sol.	Gms. BaO per 100 gms. sat. sol.	Density	pH	Solid Phase
0.0	2.92	1.038		$Ba(OH)_2 \cdot 8H_2O$
---	2.895	1.037		3:1:x
---	2.91	1.039		"
---	2.61	1.030		"
---	1.98	1.022		"
---	1.92	1.024		"
---	1.60	1.019		"
---	0.66	1.004		"
0.001	.375	1.002		"
.006	.013	1.0	9.2	"
.006	.012	1.0	9.2	"
(Ave:) .025	.031	1.0	8.4	3:1:x + 2:1:3
.033	.035	---	8.4	2:1:3
.053	.050	---	6.3	"
.156	.111	---	5.8	"
.296	.218	---	5.2	"
1.24	.75	1.021	4.6	"
2.32	3.72	1.051	3.6	"
6.78	4.08	1.094	3.0	"
12.27	7.20	1.208	2.8	"
13.66	7.82	1.230	2.7	"
15.13	8.32	1.255	2.5	"
19.08	10.71	1.353	2.3	"
23.63	12.53	1.441	2.0	"
24.44	13.12	1.450	2.0	"
25.14	13.53	1.481	1.9	"
27.60	12.59	1.502	1.5	1:1:3
30.28	11.68	1.554	1.4	"
33.59	11.27	1.576	1.2	"
38.41	10.56	1.636		"
42.01	9.93	1.691		"
43.80	9.48	1.725		"
45.10	9.32	1.750		"
46.04	9.23	1.762	1:1:2 - Metastable (1:1:3 ?)	
46.63	8.89	1.772	"	"
47.60	8.87	1.802	"	"
52.05	7.45	1.850	"	"
56.07	6.03	1.904	"	"
57.88	5.42	1.941	"	"
59.70	4.80	1.970	"	"
61.52	4.15	1.984	"	"
66.56	2.65	2.077		
46.02	8.82	1.765		1:2:3
46.15	4.30	1.605		"
46.90	2.15	1.572		"
50.48	0.35	1.602		"
55.71	.15	1.734		"
59.38	.13	1.819		"
61.36	Traces	1.868		"
67.84	--	2.061		"
71.72	--	2.172		"
71.96	--	2.181		$As_2O_5 \cdot 4H_2O$

As O

BARIUM BROMIDE $BaBr_2$

Br

SOLUBILITY OF $BaBr_2$ IN WATER

(Benrath and Lechner, 1940; Benrath, 1941)

Temp.	Gms. $BaBr_2$ per 100 gms. Sat. Sol.	Gms. $BaBr_2$ per 100 gms. H_2O	Solid Phase
-22.6°	46.6		$BaBr_2 \cdot 2H_2O$ + ice
25°	50.0	100.0	$BaBr_2 \cdot 2H_2O$
30°	50.6	102.5	"
35°	50.9	103.8	"
50°	52.5	110.5	"
75°	54.7	120.7	"
100°	56.9	132.0	"
110°	58.3	140.0	"
113°	58.5	141.0	$BaBr_2 \cdot 2H_2O$ + $BaBr_2 \cdot H_2O$
120°	59.4	146.3	$BaBr_2 \cdot H_2O$
130°	59.9	149.4	"
150°	61.4	159.0	"
160°	62.2	164.5	"
170°	62.5	166.6	"
195°	64.6	179.5	"
210°	65.4	189.0	"
225°	65.8	192.5	"
250°	68.8	220.1	"
260°	70.2	235.8	"
270°	70.7	241.2	"
280°	72.4	256.5	"
290°	74.8	296.5	"
310°	76.6	327.0	"
320°	78.2	358.5	"
337°	80.6	415.0	"
342°	81.5	440.0	"
350°o	83.0	484	$BaBr_2 \cdot H_2O$ + $BaBr_2$
372°	84.0	525	$BaBr_2$
415°	85.0	566	"

EQUILIBRIA IN THE SYSTEM BARIUM BROMIDE - BARIUM CHLORIDE - WATER

(Benrath and Lechner, 1940)

Solution					Solid		
Wt. % $BaCl_2$	Wt. % $BaBr_2$	x	m	Density	x	m	Composition
				Results at 25°			
27.0	0.0	0.0	31.4	1.323			$BaCl_2 \cdot 2H_2O$
22.8	6.90	17.49	29.4	1.338	3.42	1.97	Solid Solution I
22.4	8.16	20.4	28.6	1.351	1.45	2.24	"
21.7	9.37	23.3	28.3	1.361	1.47	2.17	"
17.86	17.03	40.2	25.3	1.400	2.51	2.12	"
12.95	26.8	59.2	21.9	1.498	4.52	2.34	"
10.44	31.9	68.2	20.4	1.560	9.01	2.47	"
9.55	34.2	71.5	19.46	1.588	14.33	2.56	"
9.12	35.4	73.1	18.92	1.614	28.1	2.20	"
8.35	36.3	75.3	18.94	1.606	31.2	2.20	"
6.17	41.3	82.1	17.65	---	41.2	1.90	"
4.28	44.2	87.8	16.89	1.696	50.6	2.15	"
3.31	46.6	90.8	16.13	1.731	76.4	2.48	"
--	--	91.5	16.00	--	--	--	S.S. I + S.S. II
2.70	47.4	92.5	16.10	1.730	93.0	2.11	Solid Solution II
0.0	50.0	100.0	16.50	1.734	--	--	$BaBr_2 \cdot 2H_2O$

Solution					Solid		
Wt. % $BaCl_2$	Wt. % $BaBr_2$	x	m	Density	x	m	Composition
				Results at 50°			
30.5	0.0	0.0	26.4	1.328	---	---	$BaCl_2 \cdot 2H_2O$
25.7	7.13	16.29	25.3	1.363	1.05	2.00	Solid Solution I
21.0	15.08	33.5	23.4	1.412	3.73	2.93	"
18.21	20.1	48.6	22.1	1.488	3.77	3.18	"
15.22	25.8	54.3	20.5	1.525	6.72	2.94	"
10.37	35.8	70.8	17.57	1.641	30.0	3.65	"
9.11	38.5	74.8	16.80	1.678	32.8	3.48	"
3.65	48.9	90.4	14.50	1.801	68.7	3.09	"
---	---	95.5	14.30	---	---	---	S.S. I + S.S. II
1.34	51.9	96.5	14.35	1.797	82.2	2.85	Solid Solution II
0.0	52.5	100.0	14.92	1.803	---	---	$BaBr_2 \cdot 2H_2O$
				Results at 75°			
33.4	0.0	0.0	23.1	1.422	---	---	$BaCl_2 \cdot 2H_2O$
31.5	2.89	6.06	22.7	1.437	0.03	2.25	Solid Solution I
29.3	6.34	13.19	22.1	1.457	1.99	2.22	"
26.5	11.09	22.7	21.0	1.489	0.34	2.20	"
25.0	13.46	27.4	20.7	1.505	1.22	2.25	"
21.7	19.03	38.0	19.50	1.552	3.59	2.35	"
19.17	22.6	44.8	19.03	1.562	5.00	2.11	"
17.70	26.2	50.9	18.01	1.611	7.53	2.05	"
16.30	28.7	55.2	17.50	1.635	9.57	2.08	"
15.24	30.7	58.5	17.05	1.661	11.60	2.39	"
12.47	36.1	67.0	15.75	1.718	27.5	3.16	"
11.15	38.8	71.0	15.10	1.757	33.7	3.29	"
9.58	42.3	75.2	14.73	1.772	33.1	2.14	"
7.26	45.3	81.4	14.08	1.818	46.2	2.46	"
6.46	46.8	83.6	13.77	1.843	47.8	2.13	"
6.16	47.9	84.5	13.40	---	59.0	3.38	"
5.00	49.1	87.3	13.51	1.855	57.2	2.74	"
4.36	50.8	89.1	13.01	1.894	85.2	2.15	"
3.95	51.3	90.1	12.98	---	90.2	2.28	S.S. I + S.S. II
1.61	53.5	95.8	13.30	1.889	95.9	2.20	Solid Solution II
0.0	54.7	100.0	13.67	1.890	---	---	$BaBr_2 \cdot 2H_2O$
				Results at 100°			
36.7	0.0	0.0	19.93	1.508	---	---	$BaCl_2 \cdot 2H_2O$
35.3	2.44	4.62	19.49	1.530	0.83	1.89	Solid Solution I
31.2	8.55	16.13	18.79	1.561	2.59	1.87	"
28.2	13.30	24.9	18.04	1.593	6.03	2.65	"
22.7	21.7	40.2	16.97	1.657	9.91	2.54	"
17.69	30.4	54.7	15.40	1.752	14.08	1.97	"
11.74	40.7	70.8	13.67	1.860	27.4	2.52	"
7.47	48.8	81.1	12.17	1.968	56.7	3.03	"
6.46	50.3	84.5	12.00	1.977	61.7	2.60	"
---	---	92.5	11.60	---	---	---	S.S. I + S.S. II
2.26	55.3	94.5	11.97	2.016	93.5	2.45	Solid Solution II
0.0	56.9	100.0	12.53	1.998	---	---	$BaBr_2 \cdot 2H_2O$

Br

x = mols. $BaBr_2$ per mol. of water free salt mixture.

m = mols. H_2O per mol. of water free salt mixture.

EQUILIBRIUM IN THE SYSTEM BARIUM BROMIDE - CADMIUM BROMIDE - WATER

(Benrath and Lechner, 1940)

Gms. $CdBr_2$ per 100 gms. sat.sol.	Gms. $BaBr_2$ per 100 gms. sat. sol.	Density	Solid Phase
		Results at 25°	
52.9	0.0	1.785	$CdBr_2 \cdot 4H_2O$
49.6	4.21	1.814	"
45.0	11.76	1.878	"
41.2	19.31	1.983	"
40.0	25.9	2.040	$CdBr_2 \cdot 4H_2O + CdBr_2$
39.6	26.7	2.165	$CdBr_2$
38.1	29.4	2.167	"
37.4	31.5	2.257	" "
37.4	32.7	2.295	$CdBr_2 + 1:1:4$
36.4	34.9	2.312	$CdBr_2 \cdot BaBr_2 \cdot 4H_2O$
36.5	34.6	---	"
34.4	36.1	2.303	"
31.1	38.7	2.300	"
30.2	39.3	2.300	$1:1:4 + BaBr_2 \cdot 2H_2O$
30.9	38.2	2.259	$BaBr_2 \cdot 2H_2O$
24.6	40.6	2.115	"
14.15	44.1	1.917	"
7.46	46.8	1.803	"
0.0	50.0	1.734	"
		Results at 30°	
56.2	0.0	1.873	$CdBr_2 \cdot 4H_2O$
49.3	9.53	1.937	"
44.3	18.52	2.056	"
43.4	20.7	2.095	$CdBr_2 \cdot 4H_2O + CdBr_2$
43.5	20.6	2.093	$CdBr_2$
40.6	24.7	2.132	"
38.0	29.7	2.205	"
37.3	31.8	2.253	"
36.6	35.0	2.353	$CdBr_2 + 1:1:4$
34.9	36.1	2.334	$CdBr_2 \cdot BaBr_2 \cdot 4H_2O$
31.5	39.1	2.311	"
30.7	39.3	2.293	$1:1:4 + BaBr_2 \cdot 2H_2O$
30.3	39.4	2.277	$BaBr_2 \cdot 2H_2O$
24.3	40.7	2.119	"
17.68	43.0	1.983	"
8.91	46.6	1.852	"
0.0	50.6	1.745	"
		Results at 35°	
59.2	0.0	1.966	$CdBr_2 \cdot 4H_2O$
56.4	3.34	1.991	"
52.7	7.36	2.016	$CdBr_2$
46.6	17.46	2.038	"
47.3	15.67	2.060	"
40.9	34.9	2.127	"
40.0	25.6	---	"
37.1	31.9	2.260	"
36.5	34.8	2.344	"
36.4	35.5	2.379	"
36.3	35.4	2.366	$CdBr_2 + 1:1:4$
33.2	38.0	2.335	$CdBr_2 \cdot BaBr_2 \cdot 4H_2O$
31.0	39.5	2.321	$1:1:4 + BaBr_2 \cdot 2H_2O$
25.4	40.9	2.152	$BaBr_2 \cdot 2H_2O$
16.49	43.8	1.972	"
15.02	44.5	1.946	"
6.57	48.0	1.831	"
0.0	50.9	1.756	"

Gms. $CdBr_2$ per 100 gms. sat. sol.	Gms. $BaBr_2$ per 100 gms. sat. sol.	Density	Solid Phase
	Results at 50°		
60.8	0.0	1.963	$CdBr_2$
51.8	9.87	2.017	"
44.6	19.11	2.086	"
40.8	24.6	2.142	"
37.6	31.6	2.289	"
36.6	37.1	2.470	$CdBr_2$ + 1:1:4
37.0	37.0	2.471	"
36.7	37.3	2.467	$CdBr_2 \cdot BaBr_2 \cdot 4H_2O$
36.1	37.5	2.470	"
35.6	38.0	2.453	"
34.3	38.8	2.434	"
33.0	39.9	2.421	1:1:4 + $BaBr_2 \cdot 2H_2O$
31.5	40.2	2.363	$BaBr_2 \cdot 2H_2O$
23.7	41.9	2.188	"
15.74	45.0	2.042	"
3.90	50.5	1.867	"
0.0	52.5	1.803	"
	Results at 75°		
61.2	0.0	2.047	$CdBr_2$
52.4	9.59	2.066	"
45.6	18.46	2.127	"
40.5	26.7	2.227	"
37.9	33.9	2.442	"
37.8	38.9	2.650	$CdBr_2$ + 1:1:4
37.1	39.6	2.642	$CdBr_2 \cdot BaBr_2 \cdot 4H_2O$
36.7	40.0	2.639	"
35.9	40.4	2.637	1:1:4 + $BaBr_2 \cdot 2H_2O$
34.8	40.7	2.586	$BaBr_2 \cdot 2H_2O$
22.5	43.9	2.211	"
15.82	46.8	2.070	"
7.42	50.9	1.971	"
0.0	54.7	1.890	"
	Results at 100°		
61.4	0.0	2.110	$CdBr_2$
56.7	5.66	2.128	"
51.9	11.32	2.153	"
40.3	28.7	2.326	"
38.8	40.1	2.860	$CdBr_2$ + 1:1:1
38.7	40.6	2.862	$CdBr_2 \cdot BaBr_2 \cdot H_2O$
37.2	41.0	2.790	1:1:1 + $BaBr_2 \cdot 2H_2O$
22.2	42.9	2.316	$BaBr_2 \cdot 2H_2O$
12.26	50.5	2.084	"
6.59	53.2	2.007	"
0.0	56.9	1.999	"

Br

BARIUM BROMATE $Ba(BrO_3)_2$

EQUILIBRIUM IN THE SYSTEM BARIUM BROMATE - BARIUM CHLORATE - WATER AT 25°

(Ricci and Smiley, 1944)

Solution			Solid*		
Wt. % $Ba(BrO_3)_2$	Wt. % $Ba(ClO_3)_2$	Density	Wt. % $Ba(BrO_3)_2$	Wt. % $Ba(ClO_3)_2$	Composition
0.791	0.0	1.001	100.0	0.0	$Ba(BrO_3)_2 \cdot 2H_2O$
.609	1.292	1.011	95.2	0.26	Solid Solution
.553	2.304	1.016	95.1	.40	"
.491	4.850	1.043	94.9	.61	"
.446	7.019	1.060	92.4	3.1	"
.423	9.370	1.985i	90.2	5.3	"
.402	10.50	1.095i	84.6	10.8	"
.347	14.41	1.131i	78.0	17.3	"
.347	14.56	1.132i	73.5	21.9	"
.310	16.83	1.151	71.5	23.7	"
.282	18.07	1.165	59.2	36.0	"
.249	19.53	1.178i	52.0	43.2	"
.235	20.50	1.186	46.4	48.6	"
.207	21.72	1.202	39.2	55.7	"
.176	22.91	1.209i	32.5	62.4	"
.145	23.85	1.217i	24.0	70.7	"
.112	24.87	1.227i	19.2	75.5	"
.078	25.87	1.242	13.0	81.6	"
.057	26.51	1.241i	5.7	88.8	"
0.0	27.54	1.249	0.0	100.0	$Ba(ClO_3)_2 \cdot H_2O$

*By extrapolation i = Interpolated value

SOLUBILITY OF BARIUM BROMATE IN POTASSIUM CHLORIDE SOLUTIONS AT 25°

(Keefer, Reiber, and Bisson, 1940)

KCl		$Ba(BrO_3)_2$	
Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O
0.0	0.0	0.02008	7.895
0.02008	1.497	.02135	8.395
.04019	2.996	.02233	8.780
.06034	4.498	.02330	9.161
.08050	6.001	.02416	9.499
.1007	7.507	.02483	9.762

SOLUBILITY OF BARIUM BROMATE IN GLYCINE SOLUTIONS AT 25°

(Keefer, Reiber, and Bisson, 1940)

Glycine		$Ba(BrO_3)_2$	
Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O
0.0251	1.88	0.02045	8.041
.0503	3.78	.02081	8.182
.0755	5.67	.02113	8.308
.1008	7.57	.02150	8.454

CH **BARIUM 2, 4di NITRO PHENATE** $Ba[C_6H_3(NO_2)_2O]_2$
BARIUM 2, 4di NITRO CRESYLATE $Ba[C_6H_2(CH_3)(NO_2)_2O]_2$
Note:

Pastac and Lecrivain (1948) determined the approximate solubility of the salts by making up mixtures with water in varying proportions, heating until the salt was dissolved, and then cooling to the desired temperature. By noting in which tubes there were no crystals,.and those in which there were, the solubility was known within limits.

At 15°, between 0.25 and 0.5 wt. % Barium 2, 4-diNitro Cresylate dissolve in water.
At 4°, between 1.0 and 2.0 wt. % Barium 2, 4-diNitro Phenate dissolve in water.
At 15°, between 0.5 and 1.0 wt. % Barium 2, 4-diNitro Phenate dissolve in water.

CH **BARIUM ANTHRACENE SULFONATES** $BaC_{14}H_8S_2O_6$, $Ba(C_{14}H_9SO_3)_2$

SOLUBILITIES IN WATER
(Federov and Lodygin, 1942)

Anthracene Sulfonic Acid	Formula	20° Gms. salt per 100 gms. sat. sol.	100° Gms. salt per 100 gms. sat. sol.
α -	$Ba(C_{14}H_9SO_3)_2 \cdot 3H_2O$	0.0706	0.8128
β -	$Ba(C_{14}H_9SO_3)_2$ ($\cdot H_2O$?)	.0196	.0787
1,5 -	$C_{14}H_8S_2O_6Ba \cdot 4H_2O$	.3667	.8480
1,8 -	"	.0599	.3170
2,6 -	$C_{14}H_8S_2O_6Ba \cdot 5H_2O$	.0457	.0946
2,7 -	$C_{14}H_8S_2O_6Ba \cdot 6H_2O$	.9019	6.7200

Cl **BARIUM CHLORIDE** $CaCl_2$

SOLUBILITY OF BARIUM CHLORIDE IN WATER
(Benrath and Lechner, 1940)

Temp.	Gms. $BaCl_2$ per 100 gms. Sat. sol.	Gms. $BaCl_2$ per 100 gms. Water	Solid Phase	Temp.	Gms. $BaCl_2$ per 100 gms. Sat. sol.	Gms. $BaCl_2$ per 100 gms. Water	Solid Phase
25°	27.0	37.0	$BaCl_2 \cdot 2H_2O$	180°	40.8	68.9	$BaCl_2 \cdot H_2O$
30°	27.7	38.3	"	200°	41.2	70.1	"
35°	28.5	39.3	"	230°	43.1	75.7	"
50°	30.5	43.8	"	250°	45.9	84.8	"
75°	33.4	50.2	"	270°	50.1	100.5	$BaCl_2$
100°	36.7	57.1	"	275°	50.0	100.0	"
107°	37.4	59.7	"} Meta-	300°	49.9	99.8	"
120°	38.3	62.1	"} stable	330°	49.4	97.6	"
150°	38.9	63.6	$BaCl_2 \cdot H_2O$	370°	0.0	0.0	"

The transition $BaCl_2 \cdot 2H_2O \rightleftharpoons BaCl_2 \cdot H_2O$ occurs at about 102°
The transition $BaCl_2 \cdot H_2O \rightleftharpoons BaCl_2$ occurs at about 270°
The transition $BaCl_2 \cdot 2H_2O \rightleftharpoons BaCl_2 \cdot H_2O$ occurs at 101.94° ± .05°
(Collins and Menzies, J. phys. chem. 40 379, (1936)).

SOLUBILITY OF BARIUM CHLORIDE IN WATER AND DEUTERIUM OXIDE

(Eddy and Menzies, 1940)

Note:

The authors used small closed vessels containing about one gram of solvent. The D_2O had a purity of 99.4%, determined from its freezing point. Including corrections for the volume of water in the vapor phase, the authors estimate the accuracy of each determination at 1%. The experimental results were plotted and the authors read the following rounded values from the curve. The original data are given as mols. of salt per 55.51 mols. of solvent.

Temp. °	Gms. $BaCl_2$ per 100 gms. H_2O	Gms. $BaCl_2$ per 100 gms. D_2O	Solid Phase
0	31.2	22.3	$BaCl_2 \cdot 2H_2O$ / $BaCl_2 \cdot 2D_2O$
5	32.3	23.6	"
10	33.5	24.9	"
15	34.6	26.5	"
20	35.8	27.7	"
25	37.1	29.1	"
30	38.1	30.3	"
35	39.4	31.9	"
40	40.8	33.2	"
45	42.1	34.5	"
50	43.3	36.0	"
55	44.8	37.3	"
60	46.2	38.6	"
65	47.7	40.1	"
70	49.4	41.4	"
75	50.8	42.7	"
80	52.5	44.0	"
85	54.2	45.5	"
90	55.8	46.9	"
93.3	57.1	47.6	$BaCl_2 \cdot 2H_2O$ / $BaCl_2 \cdot D_2O$
95	57.5	47.8	$BaCl_2 \cdot 2H_2O$ / $BaCl_2 \cdot 2D_2O$
100	59.4	48.3	"
102.1	60.0	--	$BaCl_2 \cdot H_2O$
105	60.2	49.0	$BaCl_2 \cdot H_2O$ / $BaCl_2 \cdot D_2O$
110	60.8	49.5	"
115	61.4	50.0	"
120	62.1	50.6	"
125	62.7	51.2	"
130	63.3	51.7	"
135	63.9	52.3	"
140	64.8	53.0	"
145	65.6	53.8	"
150	66.4	54.5	"
155	67.3	55.3	"
160	68.1	56.1	"
165	68.9	56.8	"
170	70.0	57.7	"
175	71.0	58.5	"
180	72.1	59.4	"

The transition $BaCl_2 \cdot 2H_2O \rightleftharpoons BaCl_2 \cdot H_2O + H_2O$ was found to occur at 102.1°, and $BaCl_2 \cdot 2D_2O \rightleftharpoons BaCl_2 \cdot D_2O + D_2O$ at 93.3°.

EQUILIBRIUM IN THE SYSTEM BARIUM CHLORIDE – BERYLLIUM CHLORIDE – WATER AT 25°

(Novoselova, Danilevich, and Tikhonova, 1946)

Gms. per 100 gms. sat. sol. $BeCl_2$	Gms. per 100 gms. sat. sol. $BaCl_2$	Solid Phase
0.0	27.17	$BaCl_2 \cdot 2H_2O$
4.92	15.66	"
10.27	6.03	"
16.17	1.04	"
21.15	0.25	"
28.56	Trace	"
35.40	"	"
43.36	"	$BaCl_2 \cdot 2H_2O + BeCl_2 \cdot 4H_2O$
43.71	"	"
43.63	0.0	$BeCl_2 \cdot 4H_2O$

EQUILIBRIUM IN THE SYSTEM BARIUM CHLORIDE - CADMIUM CHLORIDE - WATER

(Benrath and Lechner, 1940)

Gms. $CdCl_2$ per 100 gms. sat. sol.	Gms. $BaCl_2$ per 100 gms. sat. sol.	Density	Solid Phase
	Results at 25°		
54.9	0.0	1.788	$2CdCl_2 \cdot 5H_2O$
52.9	3.00	1.815	"
52.8	3.38	1.820	$2CdCl_2 \cdot 5H_2O$ + 2:1:5
52.5	3.95	1.814	$2CdCl_2 \cdot BaCl_2 \cdot 5H_2O$
43.2	7.85	1.737	"
39.4	9.89	1.706	"
33.1	14.25	1.640	"
27.7	18.40	1.606	"
27.0	18.89	1.602	2:1:5 + 1:1:4
26.2	19.53	1.599	$CdCl_2 \cdot BaCl_2 \cdot 4H_2O$
24.8	20.0	1.583	"
21.3	22.0	1.550	"
18.30	23.5	1.528	"
17.27	24.3	1.518	"
13.52	26.6	1.494	"
13.39	26.7	1.495	1:1:4 + $BaCl_2 \cdot 2H_2O$
12.56	26.8	1.480	$BaCl_2 \cdot 2H_2O$
11.56	26.7	1.465	"
6.31	27.0	1.386	"
5.35	27.0	1.370	"
0.0	27.0	1.303	"
	Results at 30°		
56.2	0.0	1.872	$2CdCl_2 \cdot 5H_2O$
54.2	3.22	1.859	$2CdCl_2 \cdot 5H_2O$ + 2:1:5
51.2	4.36	1.814	$2CdCl_2 \cdot BaCl_2 \cdot 5H_2O$
47.8	6.01	1.770	"
36.6	12.62	1.665	"
31.4	16.26	1.635	"
26.9	20.0	1.620	2:1:5 + 1:1:4
26.4	20.4	1.618	$CdCl_2 \cdot BaCl_2 \cdot 4H_2O$
24.1	21.6	1.596	"
20.0	22.6	1.576	"
15.46	26.6	1.527	"
14.10	27.4	1.520	1:1:4 + $BaCl_2 \cdot 2H_2O$
9.90	27.5	1.449	$BaCl_2 \cdot 2H_2O$
6.26	27.6	1.396	"
0.0	27.7	1.313	"
	Results at 35°		
57.3	0.0	1.858	$CdCl_2 \cdot H_2O$ (Metastable)
55.2	3.23	1.886	"
54.9	3.35	1.877	$CdCl_2 \cdot H_2O$ + 2:1:5
52.3	5.54	1.808	$2CdCl_2 \cdot BaCl_2 \cdot 5H_2O$
40.1	10.89	1.707	"
31.7	16.87	1.652	"
26.3	21.5	1,636	2:1:5 + 1:1:4
24.0	22.6	1.618	$CdCl_2 \cdot BaCl_2 \cdot 4H_2O$
21.0	24.2	1.586	"
16.60	26.8	1.556	"
15.15	27.9	1.550	1:1:4 + $BaCl_2 \cdot 2H_2O$
10.44	28.1	1.469	$BaCl_2 \cdot 2H_2O$
4.86	28.2	1.383	"
0.0	28.5	1.319	

Cl

Gms. $CdCl_2$ per 100 gms. sat. sol.	Gms. $BaCl_2$ per 100 gms. sat. sol.	Density	Solid Phase
	Results at 50°		
57.2	0.0	1.853	$CdCl_2 \cdot H_2O$
55.1	3.38	1.890	"
54.3	4.86	1.903	$CdCl_2 \cdot H_2O$ + 2:1:5
52.9	5.53	1.883	$2CdCl_2 \cdot BaCl_2 \cdot 5H_2O$
40.0	12.80	1.750	"
34.5	16.95	1.719	"
27.2	23.2	1.699	"
26.1	24.5	1.699	2:1:5 + 1:1:4
24.9	25.3	1.681	$CdCl_2 \cdot BaCl_2 \cdot 4H_2O$
22.4	26.8	1.670	"
20.7	27.7	1.660	"
17.91	29.6	1.639	1:1:4 + $BaCl_2 \cdot 2H_2O$
16.08	29.9	1.604	$BaCl_2 \cdot 2H_2O$
5.17	30.1	1.405	"
0.0	30.5	1.328	"
	Results at 75°		
58.0	0.0	1.908	$CdCl_2 \cdot H_2O$
55.3	3.90	1.942	"
52.8	7.64	1.986	"
52.6	8.53	1.998	$CdCl_2 \cdot H_2O$ + 2:1:5
51.6	9.09	1.994	$2CdCl_2 \cdot BaCl_2 \cdot 5H_2O$
41.1	15.73	1.880	"
30.6	24.4	1.836	"
27.1	29.2	1.846	"
27.1	29.7	1.850	2:1:5 + 1:1:4
26.3	30.0	1.850	$CdCl_2 \cdot BaCl_2 \cdot 4H_2O$
23.9	31.5	1.833	"
22.7	32.2	1.822	1:1:4 + $BaCl_2 \cdot 2H_2O$
20.5	32.7	1.764	$BaCl_2 \cdot 2H_2O$
14.55	32.7	1.628	"
9.57	32.7	1.542	"
0.0	33.4	1.422	"
	Results at 100°		
59.2	0.0	1.993	$CdCl_2 \cdot H_2O$
56.7	3.47	2.004	"
54.0	6.90	2.028	"
50.7	12.44	2.090	$CdCl_2 \cdot H_2O$ + 2:1:5
46.7	15.45	2.064	$2CdCl_2 \cdot BaCl_2 \cdot 5H_2O$
36.5	23.8	1.989	"
30.8	30.5	2.021	"
28.9	34.1	2.078	2:1:5 + 1:1:3
28.0	34.9	2.066	$CdCl_2 \cdot BaCl_2 \cdot 2H_2O$
28.0	35.0	2.065	"
28.9	35.0	2.065	1:1:3 + $BaCl_2 \cdot 2H_2O$
22.3	35.1	1.936	$BaCl_2 \cdot 2H_2O$
19.16	35.3	1.848	"
10.34	35.7	1.672	"
3.46	36.3	1.550	"
0.0	36.7	1.508	"

Cl

EQUILIBRIUM IN THE SYSTEM BARIUM CHLORIDE - SODIUM CHLORIDE - WATER AT 20°

(Bezuglyi and Kutsakov, 1939)

The data agree well with those of Schreinemakens and de Baat and of Frecht and Wittgen, and of Rudorf (Vol. I, p. 159), but not with those of Dicapua and Bertoni (Vol. I, p. 160).

Gms. $BaCl_2$ per 100 gms. sat. sol.	Gms. NaCl per 100 gms. sat. sol.	Solid Phase	Gms. $BaCl_2$ per 100 gms. sat. sol.	Gms. NaCl per 100 gms. sat. sol.	Solid Phase
16.89	7.8	$BaCl_2 \cdot 2H_2O$	4.17	21.23	$BaCl_2 \cdot 2H_2O$
10.04	14.5	"	3.07	24.59	$BaCl_2 \cdot 2H_2O$ + NaCl
6.51	18.52	"	1.65	25.28	NaCl

C1

INVARIANT SOLUTIONS IN THE SYSTEM $BaCl_2$ - KCl - NaCl - H_2O

(Yanatieva, 1947)

Temp.	Gms. per 100 gms. sat. sol.			Density	Solid Phases
	KCl	NaCl	$BaCl_2$		
0°	12.64	9.17	6.60	1.237	KCl + NaCl + $BaCl_2 \cdot 2H_2O$
25°	15.94	8.77	7.14	1.262	"
50°	18.74	7.91	8.87	1.295	"

SOLUBILITY OF BARIUM CHLORIDE IN ALCOHOL SOLUTIONS AT 20°

(Grinberg and Zemlyakova, 1948)

System	Gms. per 100 gms. sat. sol.*
$BaCl_2$ in 50% alcohol	5.10
$BaCl_2 \cdot 2H_2O$ in 50% alcohol	5.82
$BaCl_2$ in 50% alcohol saturated with benzene	5.43
$BaCl_2 \cdot 2H_2O$ in 50% alcohol saturated with benzene	5.82
$BaCl_2$ in 50% alcohol saturated with chloroform	6.02
$BaCl_2 \cdot 2H_2O$ in 50% alcohol saturated with chloroform	6.82

*Each figure is the average of several determinations.

EQUILIBRIUM IN THE SYSTEM BARIUM CHLORIDE - DIOXANE - WATER AT 25°

(Bogardus and Lynch, 1943)

Gms. $BaCl_2$ per 100 gms. sat. sol.	Gms. Dioxane per 100 gms. sat. sol.	Solid Phase	Gms. $BaCl_2$ per 100 gms. sat. sol.	Gms. Dioxane per 100 gms. sat. sol.	Solid Phase
26.1	1.8	$BaCl_2 \cdot 2H_2O$	4.48	58.0	$BaCl_2 \cdot 2H_2O$
25.0	4.0	"	1.96	68.7	"
22.9	9.6	"	1.21	72.4	"
20.2	15.8	"	0.64	76.1	"
17.0	22.6	"	.01	89.9	"
11.2	37.2	"	.00	93.73	"
9.51	41.2	"	.00	98.20	"
8.15	45.6	"	.00	99.05	"
5.45	54.4	"	.00	99.58	$BaCl_2 \cdot 2H_2O$ + $BaCl_2$

SOLUBILITY OF $BaCl_2$ IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

0.22 gms. $BaCl_2$ dissolve in 100 gms. Ethylenediamine (Solid phase = $BaCl_2 \cdot 4C_2H_4(NH_2)_2$).

45.2 gms. $BaCl_2$ dissolve in 100 gms. Monoethanolamine.

36.8 gms. $BaCl_2$ dissolve in 100 gms. Ethylene Glycol.

Melting point data are given for the following systems:

$BaCl_2 + BaF_2$
$BaCl_2 + SrCl_2$
$BaCl_2 + SrF_2 \rightleftharpoons BaF_2 + SrCl_2$ } (Bergman and Bukalova, 1949)

$BaCl_2 + Na_2SO_4 \rightleftharpoons 2NaCl + BaSO_4$ (Speranskaya, 1943)

$BaCl_2 + CaCl_2 + NaCl$ (Bergman and Pavlenko, 1940)

$BaCl_2 + 2Li \rightleftharpoons Ba + 2LiCl$ at 850° (Jellinek and Gzerwinski, 1924)

$BaCl_2 + NaCl$ [Density, viscosity, conductivity, surface tension] (Barzakovskii, 1940).

BARIUM PERCHLORATE $Ba(ClO_4)_2$ ClO

SOLUBILITY OF BARIUM PERCHLORATE IN ORGANIC SOLVENTS AT 20°

(Semenchenko and Shakparonov, 1948)

Solvent	Moles $Ba(ClO_4)_2$ per liter of sat. sol.	Solvent	Moles $Ba(ClO_4)_2$ per liter of sat. sol.
$CH_3COOC_2H_5$	0.274	C_2H_5OH	0.125
n - C_4H_9OH	.113	i - C_4H_9OH	.110
$(CH_3)_2CO$	.177	CH_3OH	.172
C_3H_7OH	.120	H_2O	.094

BARIUM CHROMATE $BaCrO_4$ CrO

SOLUBILITY IN SALT SOLUTIONS

(Beyer and Rieman, 1948)

The authors added 10 ml. of 0.01N NH_3, in order to prevent hydrolysis of the Barium Chromate, and diluted each solution to 1 liter.

Temp.	Added Salt	Gms. Added Salt per 1000 cc sol.	Gms. $BaCrO_4$ per 1000 cc sol.
40°	None	0.0	0.00378
25°	"	0.0	.00291
"	Sodium Acetate	0.21	.00355
"	"	0.82	.00459
"	"	1.84	.00537
"	"	3.28	.00636
"	"	5.12	.00722
"	"	7.38	.00823
"	"	10.05	.00917
"	"	13.13	.01019
"	"	16.61	.01077
"	"	20.51	.01201
"	Sodium Chloride	3.65	.00709
"	"	14.61	.01133
"	Potassium Chloride	4.66	.00717
"	"	18.64	.01158

F BARIUM FLUORIDE BaF_2

Melting point data for the system BaF_2 + SrF_2 are given by Bergman and Bukalova, 1949.

IO BARIUM IODATE $Ba(IO_3)_2$

SOLUBILITY OF BARIUM IODATE IN SOLUTIONS CONTAINING AMMONIA AT 25°

(Derr and Vosburgh, 1943)

Gms. NH_3 per 1000 gms. H_2O	Gms. NH_4Cl per 1000 gms. H_2O	Gms. $Ba(IO_3)_2$ per 1000 gms. H_2O
0.0	0.0	0.394
0.0	1.83	.413
2.864	--	.401
6.662	--	.404
15.22	--	.375
17.30	--	.373

SOLUBILITY OF BARIUM IODATE IN SOLUTIONS OF ELECTROLYTES AT 25°

(Naidich and Ricci, 1939)

Added Electrolyte	Gms. Added Electrolyte per 1000 cc sol.	Gms. $Ba(IO_3)_2$ per 1000 cc sol.	Added Electrolyte	Gms. Added Electrolyte per 1000 cc sol.	Gms. $Ba(IO_3)_2$ per 1000 cc sol.
KCl	0.0	0.3984	KNO_3	.51	0.4086
"	0.07	.4072	"	1.011	.4354
"	.37	.4374	"	2.481	.4593
"	.75	.4529	"	.25	.5739
"	3.736	.5496	"	.51	.6655
"	7.470	.6212	"	1.01	.8575
"	18.29	.7630	"	4.962	1.116
"	36.59	.9232	"	9.925	1.577
"	73.19	1.159			
			HNO_3	0.0694	0.4119
HCl	0.004	0.4019	"	.3469	.4472
"	.018	.4057	"	.6939	.4777
"	.036	.4092	"	3.469	.6699
"	.091	.4214	"	6.939	.8541
"	.182	.4378	"	15.59	1.258
"	.365	.4655	"	31.18	1.919
"	1.828	.6207	"	62.36	3.351
"	3.654	.7586			
"	8.950	1.085			
"	17.899	1.578			
"	35.803	2.554			

SOLUBILITY OF BARIUM IODATE IN POTASSIUM CHLORIDE SOLUTIONS AT 25°

(Keefer, Rieber, and Bisson, 1940)

KCl		$Ba(IO_3)_2$	
Mols. per 1000 gms. of water	Gms. per 1000 gms. of water	Mols. per 1000 gms. of water	Gms. per 1000 gms. of water
0.0	0.0945	0.000811	0.3951
0.001267	0.0945	.000831	.4049
.002533	.1888	.000847	.4127
.005064	.3775	.000877	.4273
.01003	.7477	.000922	.4492
.01254	.935	.000940	.4580
.02514	1.874	.001016	.4950
.05025	3.746	.001121	.5462
.07543	5.623	.001206	.5876
.1007	7.507	.001272	.6197

IO

SOLUBILITY OF BARIUM IODATE IN GLYCINE AND ALANINE SOLUTIONS AT 25°

(Keefer, Rieber, and Bisson, 1940)

Glycine		$Ba(IO_3)_2$		Alanine		$Ba(IO_3)_2$	
Mols. per 1000 gms. of water	Gms. per 1000 gms. of water	Mols. per 1000 gms. of water	Gms. per 1000 gms. of water	Mols. per 1000 gms. of water	Gms. per 1000 gms. of water	Mols. per 1000 gms. of water	Gms. per 1000 gms. of water
0.0251	1.884	0.000831	0.4049	0.0251	2.236	0.000829	0.4039
.0503	3.776	.000851	.4146	.0503	4.481	.000843	.4107
.0755	5.668	.000871	.4244	.0755	6.726	.000858	.4180
.1008	7.567	.000895	.4360	.1008	8.980	.000876	.4268
.1990	14.94	.000977	.4760				
.8175	61.37	.001552	.7561				

SOLUBILITY OF BARIUM IODATE IN SOLUTIONS CONTAINING GLYCINE AND POTASSIUM CHLORIDE AT 25°

(Keefer, Rieber, and Bisson, 1940)

KCl		Glycine		$Ba(IO_3)_2$	
Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O
0.02516	0.1876	0.02511	1.885	0.001035	0.5043
.02519	.1878	.05030	3.776	.001056	.5145
.02522	.1880	.07552	5.669	.001078	.5252
.02525	.1882	.1008	7.567	.001100	.5359
.05036	.3754	.02513	18.87	.001142	.5564
.05041	.3758	.05032	37.78	.001166	.5681
.05047	.3763	.07558	56.74	.001190	.5798
.05053	.3767	.1009	75.75	.001213	.5910
.1009	.7522	.02517	18.90	.001297	.6319
.1010	.7530	.05041	37.84	.001321	.6436
.1011	.7537	.07570	56.83	.001346	.6558
.1012	.7544	.1010	75.82	.001371	.6680

SOLUBILITY OF BARIUM IODATE IN DIOXANE - WATER MIXTURES AT 25°

(Davis and Ricci with Sauter, 1939)

IO

Wt. % Dioxane	Mol. % Dioxane	Density of solvent	Mols. $Ba(IO_3)_2$ per 1000 cc sat. sol.	Gms. $Ba(IO_3)_2$ per 1000 cc sat. sol.
0	0.0	0.9970	0.0008145	0.3968
10	2.223	1.0030	.0004742	.2310
20	4.667	1.0097	.0002526	.1231
30	8.063	1.0189	.0001217	.0593
40	12.004	1.0263	.0000553	.0269
50	16.987	1.0311	.0000278	.0135
60	23.485	1.0345	.0000140	.0068
70	32.32	1.0372	.0000110	.0054
80	45.01	1.0349	.0000074	.0036
90	64.81	1.0295	.00000050	.00024
100	100.0	1.0277	.00000000	.00000

SOLUBILITY OF BARIUM IODATE IN UREA SOLUTIONS

(Pederson, 1941)

Solid Phase = $Ba(IO_3)_2 \cdot H_2O$

Temp.	Moles Urea per liter of solvent	Moles $Ba(IO_3)_2$ per liter of sat. sol.
18.0°	0.0	0.0006706
17.9°	0.0	.0006694
17.9°	0.200	.0006965
17.9°	.400	.0007240
17.9°	.600	.0007510
17.9°	.800	.0007787
17.9°	1.000	.0008059

NO **BARIUM NITRATE** $Ba(NO_3)_2$

100 gms. of saturated furfural solution contains 0.01 gm. $Ba(NO_3)_2$ at 25° (Trimble, 1941).

The distribution of methylene blue between the solution and mixed crystals with barium nitrate has been studied by Chlopin and Tolstaja (1940) at 0° and 25°, and by Ioffe and Nitikin (1942a) at 0°.

Melting point data are given for the following:

$Ba(NO_3)_2$ + NaCl (Speranskaya, 1943)

$Ba(NO_3)_2$ + $NaNO_3$ + NH_4NO_3 (Campbell and Campbell, 1947)

Crystallographic data on solid solutions of $Ba(NO_3)_2$ + $Pb(NO_3)_2$ + methylene blue are given by Neuhaus (1941).

BARIUM OXIDE BaO

O

EQUILIBRIUM IN THE SYSTEM BARIUM OXIDE - SUCROSE - WATER AT 75°

(Hachihama, 1927)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
BaO	$C_{12}H_{22}O_{11}$		BaO	$C_{12}H_{22}O_{11}$	
34.00	0.0	$BaO \cdot 9H_2O$	0.70	1.59	1:1
34.82	.67	$BaO \cdot 9H_2O$ + 1:3	.61	2.27	"
33.34	.83	1:3	.58	7.08	"
33.24	.73	"	.68	12.69	"
29.62	.67	"	.66	19.05	"
28.79	.78	"	.72	25.12	"
27.82	.67	"	.72	27.27	"
26.76	.48	"	.72	34.11	"
25.08	.99	1:3 + 1:1	.89	41.13	"
25.09	1.00	"	1.03	51.95	"
24.81	1.09	1:1	0.78	58.90	"
23.92	0.97	"	.73	62.94	"
23.07	.79	"	.56	72.31	"
20.79	.68	"	.48	79.06	1:1 + $C_{12}H_{22}O_{11}$
19.11	.40	"	.46	79.81	"
9.36	.15	"	0.0	78.58	$C_{12}H_{22}O_{11}$
3.62	.17	"			

1:1 = $C_{12}H_{22}O_{11} \cdot BaO$ 1:3 = $C_{12}H_{22}O_{11} \cdot 3BaO$

The following systems have been studied:

$BaO + SiO_2$ (Austin, 1947)

$BaO + SiO_2 + Na_2O$ (Kumanin, 1940) and in part by (Greene and Morgan, 1941)

$BaO + Bi_2O_3 + O$ (Aurivillius, 1943)

$BaO + BeO$ (Geller, Yavorsky, Steierman, Creamer, 1946)

BARIUM HYDROXIDE $Ba(OH)_2$

OH

Oka (1940) found the solubility in water to be 0.28 moles per liter by potentiometric titration.

100 gms. of saturated solution of Barium Hydroxide in furfural contains 9.0 gms. $Ba(OH)_2 \cdot 8H_2O$. (Trimble, 1941)

Seward (1945) reports the melting point of $Ba(OH)_2$ with $BaBr_2$, $BaCO_3$, $BaCl_2$, and NaOH added.

S BARIUM SULFIDE BaS

SOLUBILITY OF BARIUM SULFIDE IN WATER

(Chorower, 1941)

The author discusses the reaction $2BaS + 2H_2O \longrightarrow Ba(OH)_2 + Ba(SH)_2$ and concludes that the best separation of the products ($Ba(OH)_2$ and $Ba(SH)_2$) can be made at 80° when the solubilities BaO : BaS are in the ratio 31:20.

Temp.	Gms. BaS per 100 gms. sat. sol.	Gms. BaS per 100 gms. H_2O	Temp.	Gms. BaS per 100 gms. sat. sol.	Gms. BaS per 100 gms. H_2O
0°	2.80	2.88	60°	21.69	27.69
5°	3.56	3.69	65°	24.57	32.57
10°	4.66	4.89	70°	27.19	37.35
15°	5.93	6.30	75°	30.33	43.53
20°	7.28	7.86	80°	33.29	49.91
25°	8.22	8.95	85°	36.60	57.72
30°	9.40	10.38	90°	40.24	67.34
40°	12.96	14.89	95°	39.14	64.30
45°	15.33	18.11	100°	37.61	60.29
50°	17.62	21.39	103°	37.70	60.51
55°	19.57	24.33			

The reaction of BaS + Cu_2O at 700° was studied by Schenck and Keuth, 1940.

SH BARIUM Hydrogen SULFIDE $Ba(SH)_2$

SOLUBILITY OF BARIUM HYDROGEN SULFIDE IN WATER

(Bezuglyi and Kutsakov, 1939)

Temp.	Gms. $Ba(SH)_2$ per 100 gms. sat. sol.	Temp.	Gms. $Ba(SH)_2$ per 100 gms. sat. sol.
-15°	32.0	60°	36.2
0°	32.6	80°	39.0
20°	32.8	100°	43.7
40°	34.5		

At 20°, a solution saturated with $Ba(SH)_2 + BaCl_2 \cdot 2H_2O$ contains 22.3% $Ba(SH)_2$ and 14.0% (by wt.) $BaCl_2$.

At 20°, a solution saturated with $Ba(SH)_2$ + NaHS contains 0.15% $Ba(SH)_2$ and 40.85% (by wt.) NaSH.

Data are given for the quaternary system $Ba(SH)_2 + 2NaCl \rightleftharpoons 2NaHS + BaCl_2$

Bezuglyi and Kutsakov, 1939.

SO

BARIUM SULFATE $BaSO_4$

SOLUBILITY OF BARIUM SULFATE IN MIXTURES OF WATER AND ETHYL ALCOHOL AT 25°

(Norberg and Clemedson, 1942)

The data were obtained from conductivity measurements. The results are higher than those previously reported values (Vol. I, p. 182).

Solvent	Gram-Equivalents $BaSO_4$ per liter	Gms. $BaSO_4$ per liter of solvent
Water	3.270×10^{-5}	0.00382
10% Ethyl Alcohol	1.251×10^{-5}	.00146
20% " "	3.821×10^{-6}	.000446
30% " "	1.650×10^{-6}	.000193
40% " "	4.771×10^{-7}	.0000557

Huff (1947) found precipitated barium sulfate to be more soluble in solutions containing 0.01 - 0.06 M H_2SO_4 than in pure water, but when 0.15 M H_2SO_4 was present, coprecipitation of the excess sulfate ions during precipitation more than counter balanced the increased solubility.

SONH

BARIUM SULFAMATE $Ba(SO_3NH_2)_2$

SOLUBILITY OF BARIUM SULFAMATE IN WATER

(King and Hooper, 1941)

The anhydrous salt is the stable phase throughout the temperature range studied.

Temp.	Gms. $Ba(SO_3NH_2)_2$ per 100 gms. H_2O	Temp.	Gms. $Ba(SO_3NH_2)_2$ per 100 gms. H_2O
0.0°	18.29	50.0°	43.35
10.0°	22.28	60.0°	49.56
20.0°	26.79	70.0°	55.50
*25.0°	29.7	75.0°	58.77
30.0°	32.50	85.0°	64.16
40.0°	38.50	100.2°	73.5

*Interpolated. Cupery (1938) found the solubility to be 34.2 gms. per 100 gms. of water at 25°.

SO

BARIUM THIOSULFATE BaS_2O_3

SOLUBILITY OF BARIUM THIOSULFATE IN WATER

(Luchinskii and Suzdaleva, 1940)

T°	Gms. BaS_2O_3 per 100 gms. sat. sol.	T°	Gms. BaS_2O_3 per 100 gms. sat. sol.
10°	0.194	35°	0.309
15°	.221	40°	.329
20°	.243	50°	.366
25°	.266	60°	.399
30°	.288		

SOLUBILITY OF BARIUM THIOSULFATE IN AQUEOUS ETHANOL SOLUTIONS AT 15°
(Luchinskii and Snzdaleva, 1940)

Wt. % C_2H_5OH	Gms. BaS_2O_3 per 100 gms. sat. sol.	Wt. % C_2H_5OH	Gms. BaS_2O_3 per 100 gms. sat. sol.
0	0.221	20	0.0323
1	.201	30	.0119
2	.183	40	.0054
5	.134	50	.0038
10	.0807	60	.0034
15	.0504		

SeO **BARIUM SELENATE** $BaSeO_4$

9.23 mg. $BaSeO_4$ dissolve in 100 ml. of water at 10° (Dolique, 1943).

WO **BARIUM TUNGSTATE** $BaWO_4$

From conductivity measurements, Berkem (1943) found the solubility to be 5.0×10^{-5} gm. equiv. per liter (0.0096 gms. per liter of solution) at 25°.

Cl **BERYLLIUM CHLORIDE** $BeCl_2$

0.335 gms. $BeCl_2$ dissolve in 100 cc of a mixture of equal volumes of ether and water which is saturated with HCl at 0°. (Fischer and Seidel, 1941).

SOLUBILITY OF BERYLLIUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 0°
(W. Seidel and W. Fischer, 1941)

The results agree with those of Leikina and Nowosselowa (Vol. I p. 189)

Gms. HCl per 100 gms. sat. sol.	Gms. $BeCl_2$ per 100 gms. sat. sol.	Solid Phase
11.6	31.2	$BeCl_2 \cdot 4H_2O$
20.7	22.3	$BeCl_2 \cdot 2H_2O$
20.8	22.1	"

F **BERYLLIUM FLUORIDE** BeF_2

SOLUBILITY IN WATER AND ETHANOL AT 25°
(Linnell and Haendler, 1948)

Beryllium fluoride is extremely soluble but dissolved very slowly in water, and did not reach the saturation value within two months of constant agitation. The authors sampled the solution periodically, and extrapolated their data to find the equilibrium value of the solubility. [18 molar, 846 gms. per liter of solution; density = 1.55] At saturation, the ratio $BeF_2 : H_2O$ was about 2.2. The gain in weight of BeF_2 when exposed to various vapor pressures of water was also determined, and limiting ratios of $BeF_2:H_2O$ in the solid of 1:2, 1:2.5, and 1:5 were found. From conductance and freezing point data it is estimated that a 1 molar solution of the salt is only 2% ionized. The solubility in 100% Ethyl Alcohol is about 1 gm. per liter.

EQUILIBRIUM IN THE SYSTEM BERYLLIUM FLUORIDE - AMMONIUM FLUORIDE - WATER AT 25°

(Novoselova and Averkova, 1939)

F

Saturated Solution Wt. %		Solid Phase Wt. %		Solid Phase
% NH_4F	% BeF_2	% NH_4F	% BeF_2	
43.40	---	---	---	NH_4F
43.20	0.50	95.49	0.12	"
43.40	2.49	65.07	25.60	$NH_4F + 2NH_4F \cdot BeF_2$
37.30	4.14	---	---	$2NH_4F \cdot BeF_2$
25.85	5.06	54.89	32.43	"
20.60	6.30	---	---	"
19.08	7.00	56.07	36.18	"
17.40	8.76	52.90	34.40	"
16.20	10.60	---	---	$2NH_4F \cdot BeF_2$ + Solid Solution
17.50	13.21	56.90	39.17	Solid Solution
18.07	15.42	---	---	"
18.97	17.75	56.90	40.98	"
20.15	20.16	---	---	"
20.37	22.05	---	---	"
21.57	22.48	48.80	41.30	"
21.80	25.10	49.73	48.10	Solid Solution + $NH_4F \cdot BeF_2$
21.74	25.00	39.55	48.70	$NH_4F \cdot BeF_2$
21.80	24.70	41.07	53.05	"
19.30	25.10	40.12	50.57	"
18.76	26.90	---	---	"
16.50	28.50	38.35	51.10	"
15.60	30.40	---	---	"
15.45	33.70	34.30	49.66	"

X-ray and thermal data are reported for the system BeF_2 + NaF by Novoselova, Levina, Simanov, and Zhasmin, (1944). The substances form 1:1, 1:2, and 2:1 compounds.

X-ray data for the system BeF_2 + LiF indicate the formation of 1:1 and 1:2 compounds. (Thilo and Lehmann, 1949).

BERYLLIUM NITRATE $Be(NO_3)_2$

NO

10 ml. of a saturated solution of beryllium nitrate in ether contain 0.2 gm. BeO. (Wells, 1930).

BERYLLIUM OXIDE BeO

O

The following systems have been studied:

$BeO + MgO + Al_2O_3$	Geller, Yavorsky, Steierman, Creamer (1949)
$BeO + CaO + Al_2O_3$	
$BeO + ThO_2 + Al_2O_3$	
$BeO + ZrO_2 + Al_2O_3$	
$BeO + ZrO_2$	Marbaker (1948)

BERYLLIUM HYDROXIDE $Be(OH)_2$

OH

Oka (1940) found the solubility of beryllium hydroxide in water to be 1.4×10^{-7} moles per liter by potentiometric titration.

SO BERYLLIUM SULFATE $BeSO_4$

SOLUBILITY OF BERYLLIUM SULFATE IN WATER

(Rohmer, 1943)

The stable phases in the system are: -18.5° (eutectic) to -16.4°, $BeSO_4 \cdot 5H_2O$; -16.4° to 76°, $BeSO_4 \cdot 4H_2O$; 76° to 109.4° (Boiling point) $BeSO_4 \cdot H_2O$. The solubility curve of the 4 - hydrate was followed metastably from the eutectic (-21.5°) to the boiling point (117°) and $BeSO_4 \cdot 2H_2O$ was found to exist wholly metastably from 88.4° to 110° (boiling point). In order to determine the composition of the phase stable between -18.5° and -16.4° ($BeSO_4 \cdot 5H_2O$), the author studied part of the system $BeSO_4 - H_2SO_4 - H_2O$ at -17.5°, (See next paper, below). Extrapolation of the tie lines indicated the existence of the 5-hydrate.

Temp.°	Gms. $BeSO_4$ per 100 gms. sat. sol.	Solid Phase	Temp.°	Gms. $BeSO_4$ per 100 gms. sat. sol.	Solid Phase
0	0.0	ice	75	38.7	$BeSO_4 \cdot 4H_2O$
-2	7.4	"	76	39.0	$BeSO_4 \cdot 4H_2O$ + $BeSO_4 \cdot H_2O$
-7	16.9	"	80	37.5	$BeSO_4 \cdot H_2O$
-10	19.8	"	85	35.7	"
-15	22.7	"	90	33.8	"
-18.5	24.0	ice + $BeSO_4 \cdot 5H_2O$	95	31.9	"
*-21.5	24.8	ice + $BeSO_4 \cdot 4H_2O$	100	30.0	"
-16.4	25.0	$BeSO_4 \cdot 5H_2O$ +	105	28.1	"
-10	25.2	$BeSO_4 \cdot 4H_2O$	109.4	26.%	"
-5	25.7	"			
0	26.1	"	*80	40.0	$BeSO_4 \cdot 4H_2O$
5	26.5	"	*85	41.6	"
10	27.0	"	*88.4	42.6	$BeSO_4 \cdot 4H_2O$ + $BeSO_4 \cdot 2H_2O$
15	27.5	"	*90	43.0	$BeSO_4 \cdot 4H_2O$
20	28.0	"	*95	44.5	"
25	28.5	"	*100	46.2	"
30	29.1	"	*105	47.9	"
35	29.8	"	*110	49.4	"
40	30.7	"	*115	51.0	"
45	31.6	"	*117	51.6	"
50	32.6	"			
55	33.9	"	*95	42.8	$BeSO_4 \cdot 2H_2O$
60	35.1	"	*100	43.0	"
65	36.3	"	*105	43.1	"
70	37.5	"	*110	43.2	"

* Indicates metastable equilibrium.

SOLUBILITY OF BERYLLIUM SULFATE IN SULFURIC ACID SOLUTIONS AT -17.5° AND 100°

(Rohmer, 1943)

Results at -17.5°

Saturated Solution Wt.%		Original Mixture Wt.%		Solid Phase Wt.%		Solid Phase
$BeSO_4$	H_2SO_4	$BeSO_4$	H_2SO_4	$BeSO_4$	H_2SO_4	
24.8	0.0	---	---	---	---	$BeSO_4 \cdot 5H_2O$
22.2	3.5	26	3	41.0	1.4	"
20.2	6.0	26	5	38.6	2.7	"
19.0	7.5	26	6	40.3	3.0	"
18.0	8.9	26	7	---	---	$BeSO_4 \cdot 5H_2O$ + $BeSO_4 \cdot 4H_2O$
17.1	10.8	24	9	---	---	$BeSO_4 \cdot 4H_2O$

Saturated Solution Wt.%		Original Mixture Wt.%		Solid Phase Wt.%		Solid Phase
$BeSO_4$	H_2SO_4	$BeSO_4$	H_2SO_4	$BeSO_4$	H_2SO_4	
			Results at 100°			
30.0	0.0	--	---	---	---	$BeSO_4 \cdot H_2O$
19.1	13.3	36	10	48.4	7.5	"
11.2	27.5	31	20	42.5	15.8	"
4.1	50.8	14	45	34.7	32.8	"
0.6	76.2	8	70	24.7	55.1	"
0.0	90.0	--	--	--	--	"
0.0	95.0	87.2	88	35.6	61.0	$BeSO_4$
*43.5	0.0	--	--	--	--	$BeSO_4 \cdot 2H_2O$
*25.8	19.7	30	18	53.0	8.7	"
*22.2	24.4	29	21	44.8	13.7	"
*12.8	37.8	19	34	37.8	72.9	"
*4.4	64.5	12	57	26.4	44.4	"
*46.0	0.0	--	--	--	--	$BeSO_4 \cdot 4H_2O$
*44.2	9.0	49	7.5	55.6	2.5	"

*Indicates metastable equilibrium

The system BeO - SO_3 - H_2O has been studied in part by Parsons (1904), Britton (1925), and Josien (1940), as well as by Sidgwick and Lewis (Vol. I, p. 194). Parsons gives data for solutions of low concentration, (up to about 6% SO_3) rich in BeO. After separating the solid phase, analysis of it always showed a small amount of SO_3 to be present [BeO:SO_3 = 1:0.05] He concluded that the solid was a solid solution of $BeSO_4$ in $Be(OH)_2$. Britton studied the precipitation of $Be(OH)_2$ from solutions of $BeSO_4$ by titration with NaOH. He found that solids of about the same composition as those of Parsons were deposited. Josien determined the solubility of $BeSO_4$ in solutions containing added BeO and H_2SO_4. He also gives data on the solubility of BeO in H_2SO_4 solutions which he attributes to Britton, but the reference is incorrect.

Composition of solutions found by Josien (1940)

SO_3		BeO	
Mols. per 1000 cc H_2O	Gms. per 1000 cc H_2O	Mols. per 1000 cc H_2O	Gms. per 1000 cc H_2O
5.78	462.7	0.63	15.8
5.05	404.3	.94	23.5
3.86	309.0	2.22	55.5
3.78	302.6	2.29	57.3
3.66	293.0	2.54	63.6
3.57	285.8	2.74	68.6
3.44	275.4	3.05	76.3
3.33	266.6	3.25	81.3
3.31	265.0	3.32	83.1
3.37	269.8	3.63	90.8
3.51	281.0	4.18	104.6
3.60	288.2	4.48	112.1
3.70	296.2	4.87	121.8
3.76	301.0	4.92	123.1
3.82	305.8	5.21	130.4
4.09	327.4	5.92	148.1
4.68	374.7	7.58	189.7

Be **BERYLLIUM**

Composition of solutions attributed to Britton, reported by Josien (1940):

Mols. SO_3 per 1000 gms. sat. sol.	Gms. H_2SO_4 per 1000 gms. sat. sol.	Mols. BeO per 1000 gms. sat. sol.	Gms. BeO per 1000 gms. sat. sol.
2.858	---	2.858	71.52
3.274	129.1	1.958	49.00
3.472	191.7	1.518	38.00
3.583	223.6	1.303	32.61
4.089	320.4	0.822	20.57
4.615	403.4	.501	12.54
5.089	465.9	.338	8.46
5.853	555.0	.194	4.86
6.417	620.2	.093	2.34
6.822	660.7	.085	2.13
6.822	661.0	.082	2.06

Bi **BISMUTH** Bi

Stohr and Klemm (1940) studied the system Bismuth-Germanium by means of thermal analysis.

The reaction $2Bi + 3PbF_2 \rightleftharpoons 3Pb + 2BiF_3$ was studied at 850° by Jellinek (1944) and $2Bi + 3PbO \rightleftharpoons Bi_2O_3 + 3Pb$ at 1100° by Jellinek and Siewers, 1932.

Br **BISMUTH BROMIDE** $BiBr_3$

The system $BiBr_3$ + Trinitrotoluene was studied by Fushin, Nikolic, et. al. (1947).

The system $BiBr_3$ + Nitro Benzene was studied by Fushin (1948a).

CH **BISMUTH CUPFERRATE** $Bi(C_6H_5N(NO)O)_3$

The solubility product of bismuth cupferrate in water is 6×10^{-28}. (Pyatnitski, 1946)

Cl **BISMUTH CHLORIDE** $BiCl_3$

Melting point data for the system $BiCl_3$ + $SbCl_3$ are given by Starckadomskaja (1939).

O **BISMUTH OXIDE** Bi_2O_3

SOLUBILITY OF BISMUTH OXIDE IN SODIUM HYDROXIDE SOLUTIONS

(Schumb and Rittner, 1943)

The authors prepared the α, β, and γ forms of Bi_2O_3 and determined their relative stability at 25° and 100°. At 100° β- and γ-Bi_2O_3 were both converted to α-Bi_2O_3 upon standing in contact with a 2N sodium hydroxide solution in a sealed platinum crucible. At 25° the β-Bi_2O_3 was changed to α-Bi_2O_3 after rotation with sodium hydroxide in a thermostat. In order to determine whether or not the γ-Bi_2O_3 was stable with respect to α-Bi_2O_3, careful solubility measurements were made, and the α-Bi_2O_3 was then found to be stable at 25° as well as at 100°.

Results at 25°

Gms. NaOH per 1000 cc sat. sol.	Gms. Bi_2O_3 per 1000 cc sat. sol.	Solid Phase
20.0	0.0063	α-Bi_2O_3
39.6	.012	"
56.4	.016	"
78.8	.023	"
98.4	.0290	"
56.8	.0190	γ-Bi_2O_3

The systems Bi_2O_3 + CaO, Bi_2O_3 + SrO and Bi_2O_3 + BaO + O were investigated by Aurivillius (1943) using X-rays.

BISMUTH SULFIDE Bi_2S_3 S

Kapustinsky (1940) calculated the solubility product of silver and other metal sulfides in water from free energy data. His value at 25° is 7.1×10^{-61} as compared with the value given by Latimer ("Oxidation States of the Elements", 1938): 1.6×10^{-72}. He then calculates the solubility of Bi_2S_3 in solutions of different acidity (25°):

pH :	3	5	7	9	11
Gm. mols. per liter:	6.1×10^{-3}	2.4×10^{-5}	1.5×10^{-7}	6.4×10^{-9}	4.0×10^{-10}

BROMINE Br_2 Br_2

Graphite will absorb 84% of its own weight of bromine when placed in an atmosphere of bromine at room temperature. This corresponds to an atomic ratio of 1Br:8C. X-ray analysis shows a solution of bromine in the graphite lattice, rather than any definite compound formation, and the bromine is given off if the product is exposed to air (Rudorff, 1941).

The cryoscopic constant of bromine was determined by Wulff (1947) to be 8.8. 0.4% Cl_2 lowers the freezing point about 1°.

Isobars for the partial pressure of Br_2 in the system Br_2 - KBr - H_2O at 20° are given by Luchinskii (1939). There are no azeotropes in the system.

EQUILIBRIUM IN THE SYSTEM BROMINE - IODINE - CHLORINE AT 29.8°

(Campbell and Shemilt, 1946)

The authors found two compounds in the system: IBr and ICl_3, but there is no solution in the system which is saturated with two solid phases. Iodine forms a continuous series of solid solutions with IBr which may contain up to 4% chlorine [some difficulty was encountered in separating the solids from the solution, and also in the determination of small amounts of chlorine.] Results are given for solutions containing less chlorine than the compound ICl_3, which could be handled in open vessels. Analyses were made by reducing the halogens with zinc and titrating potentiometrically with silver nitrate solution. The estimated accuracy was about 1%.

DATA OF CAMPBELL AND SHEMILT

Solution		Wet Solid Phase		Solid Present
Wt. % Br	Wt. % I	Wt. % Br	Wt. % I	
48.55	51.45	43.41	56.59	IBr
46.85	50.24	42.66	55.34	Solid Solution IBr + I + Cl
46.01	50.79	42.12	55.40	"
44.56	51.52	41.71	56.20	"
34.73	59.24	35.37	61.20	"
29.27	63.80	31.07	64.70	"
26.50	66.11	28.65	66.35	"
19.77	71,80	21.06	72.43	"
15.44	74.42	16.65	76.00	"
11.29	77.76	12.94	81.00	"
7.67	81.23	6.99	87.45	"
4.49	83.07	3.81	89.59	"
---	84.72	---	93.23	Iodine
---	72.60	---	65.30	ICl_3
4.04	69.91	2.58	62.92	"
11.89	64.63	6.27	60.32	"
14.96	61.94	7.29	55.58	"
16.34	60.11	8.11	56.03	"
20.72	56.35	12.22	54.45	"
40.80	36.98	18.87	48.43	"
42.71	35.18	13.50	48.93	"
61.52	22.52	32.82	36.13	"

EQUILIBRIUM IN THE SYSTEM BROMINE - TETRAMETHYLAMMONIUM BROMIDE - WATER AT 25°

(Bloch, Farkas, Schnerb, and Winogron, 1949)

Gms. per liter		Condensed Phases
$(CH_3)_4NBr$	Br_2	
562.5	0.0	$(CH_3)_4NBr$(s)
562.5	5.75	$(CH_3)_4NBr$(s) + 1:2 (s) orange
*300	4.8	1:2 (s) orange
142.0	4.5	"
* 90.0	5.05	"
50.2	6.65	1:2 (s) orange + 1:2 (s) red
40.0	7.0	1:1 (s) red + 1:4.2 (L)
17.3	5.95	1:5.15 (L) + 1:8 (S)
6.6	5.15	1:8 (s)
*1.2	7.7	"
0.28	25.3	"
0.15	32.0	Br_2(L) (99% by wt.)

*Read from the curves given by the authors.

(s) = solid (L) = liquid

1:2 = $(CH_2)_4NBr \cdot Br_2$ 1:4.2 Liquid composition $(CH_3)_4NBr \cdot Br_{4.2}$

1:8 = $(CH_3)_4NBr \cdot Br_8$ 1:5.15 " " $(CH_3)_4NBr \cdot Br_{5.15}$

Melting points in the system Bromine - Tetramethylammonium Bromide were determined by Bloch, Farkas, Schnerb, and Winogren, 1949.

CARBON TETRABROMIDE CBr_4

(See also p.569) Br

SOLUBILITY OF CARBON TETRABROMIDE IN PYRIDINE

(Davidson, Van der Werf, and Boatright, 1947)

The authors studied the entire system by means of cooling curves, and report 3 compounds of pyridine + CBr_4 : 1:1, 2:1, and 3:1, of melting points -12.5°, -7.8°, and -17° (incongruent) respectively. They present a plot of temperature vs. mole percent, from which the values below were read.

Temp.	Mole % CBr_4	Solid Phase	Temp.	Mole % CBr_4	Solid Phase
-10°	51.5	α-CBr_4	40°	78.0	α- CBr_4
0°	56.5	"	50°	82.0	β- CBr_4
10°	62.0	"	60°	86.0	"
20°	67.0	"	70°	90.5	"
30°	72.0	"	80°	94.5	"

SOLUBILITY OF CARBON TETRABROMIDE IN 2,6-DIMETHYLPYRIDINE

(Van der Werf, Davidson, and Michaelis, 1948)

The authors studied the entire system by means of cooling curves and found a 1:1 compound melting at 20.7°. The data below were read from the authors' plot of mole % vs. temperature.

Temp.	Mole % CBr_4	Solid Phase	Temp.	Mole % CBr_4	Solid Phase
20°	67.5	α - CBr_4	60°	89.5	β- CBr_4
30°	73.5	"	70°	93.5	"
40°	79.5	"	80°	96.5	"
50°	85.5	β - CBr_4	90°	99.7	"

CARBON TETRACHLORIDE CCl_4

(See also p.569) Cl

THE SYSTEM CARBON TETRACHLORIDE - GLYCEROL - ETHYL ALCOHOL AT 25°

(McDonald, Kluender, and Lane, 1942)

The solubility curve was determined by titration, and the compositions of the conjugate solutions were found by measuring the viscosity of each layer.

Upper Layer		Lower Layer	
Wt. % C_2H_5OH	Wt. % CCl_4	Wt. % C_2H_5OH	Wt. % CCl_4
17.0	75.7	27.7	20.6
9.0	89.5	25.1	13.7
5.3	94.0	19.2	7.6
3.0	96.8	12.0	3.4
0.3	99.6	4.5	1.0

THE SYSTEM CARBON TETRACHLORIDE + 1-PROPANOL + WATER AT 20°

(Denzler, 1945)

The "cloud points" were determined by titration, and the refractive indices at the cloud point compositions were determined. The tie lines were found by making up mixtures of known composition within the two phase region, and then finding the composition of the upper layer by measuring its refractive index. All refractive indices were measured at 25°, and the indices for mixtures of CCl_4 + 1-propanol at 25° are also given. Data marked (*) were interpolated by the author.

Upper Layer		Lower Layer	
Wt. % CCl_4	Wt. % C_3H_7OH	Wt. % CCl_4	Wt. % C_3H_7OH
6.8	40.9	(Plait point)	
*12.7	49.4	3.6	32.6
19.2	53.7	2.2	27.6
* 1.7	24.9	23.0	53.4
0.72	21.5	28.5	53.6
.43	20.2	35.0	51.4
.38	19.5	39.8	49.0
.30	19.0	44.1	46.4
.28	18.7	51.8	41.3
.26	18.5	63.2	32.9
* .2	16.9	68.2	28.8
* .2	16.4	75.0	23.0

Cl

The solubility of carbon tetrachloride in water and blood at 20° and 37° as a function of the concentration of the vapor in air is given by Powell (1945). The blood plasma absorbs the CCl_4, but the red cells do not, and the solubility is proportional to the fat content in the plasma.

Melting point data are given for the following:

CCl_4 + Cyclohexane (no compounds) (Kennard and McKusker, 1948a)

CCl_4 + Cyclohexanol (no compounds) (Wilson and Heron, 1941)

CCl_4 + Dioxane (1:2 compound) (Kennard and McKusker, 1948a)

CCl_4 + Pyridine (1:2 compound) (Kennard and McKusker, 1948a) (Davidson, Van der Werf, and Boatright, 1947)

CCl_4 + 2,6 Dimethylpyridine (no compounds) (Van der Werf, Davidson, and Michaelis, 1948)

CCl_4 + Anisole (no compounds) (Sisler and Cory, 1947) (Sisler, et al. 1948)

CCl_4 + Phenetole (no compounds) (Sisler, et al., 1948)

CCl_4 + Diphenyl Ether (no compounds) (Sisler and Cory, 1947)

CCl_4 + Tetrahydrofuran (no compounds) (Sisler, Batey, Pfahler, and Mattair, 1948)

CCl_4 + Methyl m-Cresyl Ether (1:1 compound) (Sisler, et al., 1948)

Also reported:

CCl_4 + Benzene (index of refraction: McMillan and McDonald, 1943) (Vapor pressure and Density: Scatchard, Wood, and Mochel, 1940) (Liquid - Vapor equilibrium data: Bushmakin and Voeikova, 1949) (Vapor pressure at 25° and 50°: Horiuchi, 1931)

CCl_4 + Benzene + Acetic Acid (index of refraction and density: McMillan and McDonald, 1943)

CCl_4 + Cyclohexane (Vapor pressure and density: Scatchard, Wood, and Mochel, 1939)

CCl_4 + C_2Cl_4 (index of refraction: McMillan and McDonald, 1943)

CCl_4 + Allyl Alcohol + H_2O (Liquid-vapor equilibrium data: Hands and Norman, 1945)

CCl_4 + CH_3OH (Density and Liquid-vapor equilibrium data: Scatchard, Wood, and Mochel, 1946a)

TETRACHLORETHYLENE C_2Cl_4 C1

The immiscibility curve in the system C_2Cl_4 + $(C_2H_5)_2O$ + H_2SO_4 at 20° is given by Tian (1946). Other curves are drawn to show the effect of adding water to the system, but at other temperatures.

FLUOROCARBONS C_nF_{2n+2} F

Scott (1948), lists the following values for the solubility of the fluorocarbons in organic solvents at 27° in terms of weight %.

C_7F_{14} = Perfluoromethylcyclohexane
C_8F_{16} = Perfluorodimethylcyclohexane
~ $C_{12}F_{26}$ = "Perfluoro Kerosene"
~ $C_{20}F_{42}$ = "Perfluoro Lube Oil"

Solvent	Grams per 100 grams of Saturated Solution			
	C_7F_{14}	C_8F_{16}	~ $C_{12}F_{26}$	~ $C_{20}F_{42}$
Methyl Alcohol	insol.	2.5	insol.	insol.
O-Dichlorbenzene	"	insol.	"	"
Acetone	10	9	"	"
Chloroform	6.9	10	1.3	"
Benzene	3	4.6	insol.	"
Ethyl Acetate	15	13	"	"
Carbon Tetrachloride	miscible	43	3.4	"
Ethyl Ether	"	miscible	19	"
"Petroleum Ether"	"	"	67	"

CYANOGEN $(CN)_2$ N

Naumann (1910) shows a curve for the weight of cyanogen dissolved in 100 gms. of water solution as a function of time. The curve seems to approach a limit of about 0.4 gms. per 100 gms. of solution, but the author states that other determinations at longer time intervals (up to two hours) gave values of 1.1 - 1.3 gms. per 100 gms. of solution. The solubility in 0.01 N HCl is at least 0.9 gms. per 100 gms. of solution.

Gay Lussac (1815) gave the solubility as about 0.98 gms. per 100 gms. of solution in water.

SOLUBILITY OF CARBON MONOXIDE IN WATER

Bunsen's data (1877) was interpolated by Henrich (1892) by using the method of least squares, and his equation expresses the solubility more closely than does Bunsen's equation. Henrich's equation: $\beta = 0.032784 - 0.00080094t + 0.000015872t^2$ (β = Bunsen coefficient, t = °C) was used to calculate the data below. These values are smaller than those of Winkler (1901)

Temp.°	β	Temp.°	β
0	0.03278	15	.024341
5	.029076	20	.023113
10	.02636	25	.022580

SOLUBILITY OF CARBON MONOXIDE IN WATER

(Cassuto, 1904)

The results were interpolated from the author's data. The values of S are from the equation $1 = SP$ where 1 is the Ostwald solubility coefficient, and P is the total pressure in meters.

Total Pressure in meters	S	
	17.7°	19°
1.000	0.02789	0.02716
2.000	.02783	.02710
3.000	.02773	.02696
4.000	.02770	.02688
5.000	.02761	.02675
6.000	.02754	.02665
7.000	.02739	.02643
8.000	.02715	.02614

SOLUBILITY OF CARBON MONOXIDE IN CUPROUS SOLUTIONS

The solubility of carbon monoxide in solutions of cuprous ammonium carbonate and of cuprous ammonium formate has been studied by Hainsworth and Titus (1921) and by Larson and Teitsworth (1922). Results are given for solutions containing from 35 gm to 125 gms. Cu^+ per liter, at temperatures from 0° to 60°, and at partial pressures of carbon monoxide from 0 cm to 260 cm of Hg. The solubility is proportional to the amount of Cu^+ in solution. With increasing pressure, the amount of carbon monoxide absorbed approaches a maximum which corresponds to 1 mol of CO per mol of Cu^+ in solution. The solutions decompose to a slight extent, precipitating metallic copper.

SOLUBILITY OF CARBON MONOXIDE IN ACID SULFATE SOLUTION AT 25°

(Kobe and Kenton, 1938)

Note: The authors determined the solubility of a number of gases in a solution of Sodium Sulfate + Sulfuric Acid which was made up from 200 gms Anhydrous Sodium Sulfate + 800 grams of water + 40 ml of 36N (conc.) H_2SO_4. They suggest the use of the solution as a confining liquid in gas analyses. The aqueous tension of the solution was determined, and may be represented by:

$$\log P = 9.2675 - \frac{2375}{T}$$

Where P is the vapor pressure in millimeters of mercury, and T is the absolute temperature. At 25° 0.0039 cc of CO [measured at 25°, 760 mm] dissolve in 1 cc of solution when the partial pressure of CO is 760 mm. This is equal to 0.0036 cc of CO measured at 0°, 760 mm.

SOLUBILITY OF CARBON MONOXIDE IN ABSOLUTE ALCOHOL

(Carius, 1855)

The author used Alcohol of specific gravity 0.792 (20°). When the temperature was varied from 2° to 24°, there was no significant change in the solubility of carbon monoxide: 0.204 ±.001 cc CO (measured at 0°, 760 mm) were dissolved per cc of water at each temperature. This result is somewhat larger than that found by others (Vol. I, p. 218), who also found a variation in solubility with temperature.

SOLUBILITY OF CARBON MONOXIDE IN ALCOHOLS

(Gjaldbak, 1948)

The following results were interpolated by the author from his experimental data, and are expressed as ml of CO (measured at 760 mm and the temperature of the experiment) dissolved in 1 ml of solvent.

Solvent	d_4^{20}	B.P. 760 mm	α_1			$\frac{d\alpha_1}{dt}$ (20°-50°)
			20°	35°	50°	
CH_3OH	0.7916	64.7	0.224	0.230	0.248	0.0008
C_2H_5OH	.7892	78.3	.200	.207	.216	.00053
n-C_3H_7OH	.8038	97.2	.177	.182	.189	.00040
i-C_3H_7OH	.7859	82.4	.190	.196	.206	.00053
n-C_4H_9OH	---	117.8	.164	.169	.173	.00030
i-C_4H_9OH	---	107.9	.174	.180	.186	.00040

CARBON DIOXIDE CO_2 O

Wolf and Krause (1927) determined the solubility of Carbon Dioxide in solutions of $CaCl_2$ + NaCl which were used as retaining liquids in gas analysis.

Very careful work by Shedlovsky and McInnes (1935) showed the solubility of carbon dioxide in water to be 0.03372 ± 0.00005 mols per liter per atmosphere pressure at 25°. Thus 1.484 grams of carbon dioxide will dissolve in one liter of water at one atmosphere pressure.

SOLUBILITY OF CARBON DIOXIDE IN WATER

(Morgan and Maass, 1931)

The authors carefully measured the partial pressure of carbon dioxide over water at various temperatures and concentrations. The following data were read from the graphs drawn by the authors. The data at 0° are somewhat less accurate than at other temperatures, but considerable care was taken throughout. Solubility is expressed in gms. CO_2 per 100 gms. sat. sol.

Temp.°	Partial Pressure of CO_2 mm			
	20	40	60	80
0	0.083	0.168	0.251	0.335
10	.060	.120	.181	.240
18	.045	.091	.138	.186
25	.036	.076	.113	.152

The Henry's law constants from the above data are:

$$K = \frac{\text{Partial pressure of } CO_2 \text{ in mm. of mercury}}{\text{Mole fraction } CO_2 \text{ in solution}}$$

		10°	18°	25°
(M. and M.)	K =	0.791	1.018	1.243
(Bohr: Vol.I, p.221)	K =	.797	1.039	1.255

SOLUBILITY OF CARBON DIOXIDE IN WATER AT VARIOUS TEMPERATURES AND PRESSURES

(Wiebe and Gaddy, 1940; Wiebe, 1941; Prutton and Savage, 1945; Zelvenskii, 1937)

The results from 12° to 100° are those given by Wiebe and Gaddy and by Wiebe. Prutton and Savage made determinations at 100° and 120° and expressed their results in terms of mole fractions. At 100° their results are practically identical with those of Wiebe. Prutton and Savage's data were recalculated in terms of the volume of carbon dioxide dissolved, and are identified by (*) in the table. Zelvenskii's data is indicated by (**).

The compositions of the vapor phases in equilibrium with many of the solutions are given by Wiebe and Gaddy, 1941.

cc of Carbon Dioxide (measured at 0°, 1 atm.) per gram of water:

Total Pressure Atm.	0°	12°	18°	25°	31.04°C	35°	40°	50°	75°	100°	120°
25	30.51**		19.51		14.18	12.95	11.62	9.71	6.82	5.37	5.0*
50		35.54	32.03	27.23	24.15	22.21	20.35	17.25	12.59	10.18	9.5*
75		36.33	33.85	31.17	29.33	27.84	25.81	22.53	17.04	14.29	13.6*
100		36.77	33.98	31.75	30.17	29.13	27.81	25.63	20.61	17.67	17.2*
125							28.71	26.77		20.1*	20.1*
150		38.39	35.75		31.59	30.52	29.39	27.64	24.58	22.73	22.1*
200		39.77	37.17		32.78	31.83	30.74	29.14	26.66	25.69	26.8*
300		41.07	39.31					31.34	29.51	29.53	30.0*
400				38.62	36.78	35.73	34.87	33.29	31.88	32.39	32.8*
500				39.74	38.67	37.99	36.73			34.4*	35.2*
600								36.73		36.4*	37.5*
700								38.34	37.59	38.50	39.9*

c=Critical temperature

SOLUBILITY OF CARBON DIOXIDE IN WATER

(Van Slyke, 1939)

The following values were read from a plot of the author's data:

Temp.	Ml. CO_2 (measured at 0°, 760 mm) per ml. water
23.0	0.802
24.0	.776
25.0	.758

Orcutt and Seevers (1937) found the solubility of CO_2 in water at 25° to be β = 0.753.

SOLUBILITY OF CARBON DIOXIDE IN WATER

(Zelvenskii, 1939)

The solubility of each gas in mixtures of CO_2 + H_2 and CO_2 + N_2 was determined at 25° and at various total pressures. β = ml. of gas (measured at 0°, 1 atm) dissolved in 1 ml. of water at room temperature.

Mixtures of Carbon Dioxide with Hydrogen

Pressure Atm.	5% CO_2		10% CO_2		15% CO_2		20% CO_2	
	CO_2	H_2	CO_2	H_2	CO_2	H_2	CO_2	H_2
25	0.82	0.395	1.62	0.361	2.50	0.335	3.40	0.309
50	1.56	0.790	3.14	0.725	4.70	0.672	6.33	0.619
75	2.26	1.180	4.53	1.080	6.64	0.998	8.73	0.915
100	2.89	1.560	5.75	1.430	8.36	1.320	10.86	1.200
125	3.48	1.940	6.87	1.780	9.86	1.630	12.67	1.480
150	3.99	2.320	7.87	2.120	11.20	1.930	14.27	1.740
175	4.47	2.690	8.77	2.450	12.37	2.230	15.55	1.990
200	4.97	3.060	9.56	2.780	13.42	2.510	16.70	2.240
225	5.37	3.430	10.28	3.110	14.33	2.800	17.67	2.480
250	5.79	3.790	10.92	3.440	15.11	3.080	18.54	2.720
275	6.18	4.160	11.49	3.750	15.77	3.350	19.30	2.950
300	6.57	4.520	11.97	4.080	16.36	3.630	20.04	3.180

Mixtures of Carbon Dioxide with Nitrogen

Pressure Atm.	5% CO_2		10% CO_2		15% CO_2		20% CO_2	
	CO_2	N_2	CO_2	N_2	CO_2	N_2	CO_2	N_2
25	0.74	0.283	1.47	0.256	2.41	0.228	3.11	0.201
50	1.38	0.566	2.75	0.513	4.21	0.458	3.52	0.403
75	1.93	0.843	3.81	0.763	5.64	0.688	7.39	0.588
100	2.32	1.110	4.61	1.010	6.81	0.907	8.87	0.772
125	2.67	1.360	5.23	1.240	7.67	1.120	9.98	0.944
150	2.99	1.600	5.75	1.460	8.35	1.310	10.90	1.110
175	3.23	1.820	6.18	1.660	8.91	1.500	11.60	1.280
200	3.40	2.040	6.52	1.860	9.36	1.670	12.15	1.430
225	3.56	2.240	6.82	2.050	9.67	1.830	12.56	1.560
250	3.70	2.430	7.05	2.220	10.03	1.970	12.90	1.680
275	3.85	2.610	7.25	2.380	10.29	2.090	13.17	1.780
300	3.99	2.780	7.41	2.530	10.50	2.210	13.43	1.860

Zaalishvili, 1940 studied the solubility of Carbon Dioxide in water when the Carbon Dioxide was mixed with Nitrogen and Hydrogen. At 10 atmospheres fugacity of CO_2:

Temp.	1 mol H_2O dissolves:	100 grams H_2O dissolve:
20°	7×10^{-3} mol CO_2	1.71 gms. CO_2
35°	5.8×10^{-3} "	1.42 "
50°	4×10^{-3} "	0.98 "

SOLUBILITY OF CARBON DIOXIDE IN SOLUTIONS OF ELECTROLYTES AT 25°

(Kobe and Williams, 1935)

l = ml. CO_2 (measured at 25°, 760 mm) dissolved in 1 ml. of solvent.
β = " " (" " 0°, 760 ml.) " " " " " "

Added Electrolyte	Wt.%	l	β	Added Electrolyte	Wt.%	l	β
None	--	0.823	0.754	Na_2SO_4	20	0.262	0.240
H_2SO_4	5	.746	.683	Na_3PO_4	10	.280	.256
"	10	.717	.657	$CaCl_2$	40	.158	.144
NaCl	10	.551	.505	$MgCl_2$	30	.164	.150
"	20*	.339	.310	$ZnCl_2$	50	.386	.354
"	25	.257	.236	$AlCl_3$	25	.243	.222
				$Al_2(SO_4)_3$	20	.221	.203

*Average of 3 determinations which do not agree very closely: l = 0.334, 0.328, 0.352; β = 0.306, 0.302, 0.323.

SOLUBILITY OF CARBON DIOXIDE IN AQUEOUS SOLUTIONS AT 25°

(Findlay and Harby, 1908)

The carbon dioxide used contained 0.7% of foreign gases l = ml. CO_2 (measured at 25°, 760 mm) dissolved in 1 ml. of solvent.

Solute	Wt.%	l	Solute	Wt.%	l
None	--	0.823	H_2SiO_3	0.113	0.823
$Fe(OH)_3$	1.36	.896		.068	.822
(dialyzed)	0.68	.877	Dextrin	20	.735
	.34	.833		10	.757
	.136	.824		5	.768
Gelatine	5	.848		1	.817
	3	.834	Soluble starch	10	.776
	1	.826		5	.801
As_2S_3	0.305	.822		1	.815
	.244	.825	Glycogen	1.18	.804
	.122	.825		0.263	.820
	.0244	.825	Albumin	.5	.822
				.75	.822

SOLUBILITY OF CARBON DIOXIDE IN AQUEOUS SALT SOLUTIONS

(Markham and Kobe, 1941)

A = ml. carbon dioxide (measured at 0°, 760 mm) per ml. solvent at given temperature

S = ml. carbon dioxide (measured at 0°, 760 mm) which dissolve in that volume of solvent which contains one gram of water.

Results at 0.2°

Gm. moles of Salt per 1000 gms. H_2O	Potassium Chloride		Sodium Chloride		Potassium Nitrate	
	A	S	A	S	A	S
0.0	1.7023	1.7025	---	---	---	---
0.1	1.6611	1.6654	---	---	1.6680	1.6740
0.2	1.6268	1.6352	1.5996	1.6043	1.6470	1.6584
0.5	1.5285	1.5481	---	---	1.5733	1.6012
1.0	1.4020	1.4389	1.2778	1.2978	1.4610	1.5142
2.0	1.1982	1.2644	0.9877	1.0210	---	---
3.0	1.0460	1.1356	.7800	0.8218	---	---
4.0	---	---	.6286	.6755	---	---

	Sodium Nitrate		Magnesium Nitrate		Magnesium Sulfate	
	A	S	A	S	A	S
0.2	1.6167	1.6247	---	---	---	---
0.5	1.5040	1.5229	1.3928	1.4172	1.1988	1.1986
1.0	---	---	1.1439	1.1863	.8441	.8470
2.0	---	---	0.7849	.8488	.4128	.4201
3.0	0.8840	0.9589	.5612	.6326	---	---
8.0	.4055	.5099	---	---	---	---

Results at 25°

	Potassium Chloride		Sodium Chloride		Potassium Nitrate	
	A	S	A	S	A	S
0.0	0.7565	0.7587	---	---	---	---
0.1	.7432	.7475	0.7379	0.7413	0.7501	0.7552
0.2	.7307	.7369	.7197	.7243	.7241	.7500
0.5	.6937	.7055	.6687	.6767	.7182	.7345
1.0	.6442	.6646	.5946	.6074	.6860	.7156
2.0	.5646	.5998	.4816	.5017	.6296	.6834
3.0	.5030	.5503	.3917	.4164	.5818	.6568
4.0	.4563	.5141	.3288	.3568	---	---

	Sodium Nitrate		Magnesium Nitrate		Magnesium Sulfate		Sodium Sulfate	
	A	S	A	S	A	S	A	S
0.1	0.7415	0.7458	---	---	---	---	---	---
.2	.7289	.7352	---	---	---	---	---	---
.25	---	---	---	---	---	---	0.6435	0.6481
.5	.6946	.7069	0.6476	0.6627	0.5580	0.5606	.5330	.5399
1.0	.6352	.6562	.5588	.5840	.4147	.4186	.3855	.3957
1.5	---	---	---	---	---	---	.2824	.2943
2.0	.5406	.5758	.4200	.4587	.2250	.2306	---	---
3.0	.4659	.5109	.3225	.3683	---	---	---	---
8.0	.2474	.3151	---	---	---	---	---	---

Results at 40°

Gm. moles of Salt per 1000 gms. H_2O	Potassium Chloride		Sodium Chloride		Potassium Nitrate	
	A	S	A	S	A	S
0.0	0.5133	0.5173	---	---	---	---
1.0	.4360	.4522	0.4084	0.4195	0.4704	0.4937
2.0	.3853	.4168	.3328	.3487	.4370	.4776
3.0	.3520	.3874	.2767	.2960	.4083	.4642

	Magnesium Nitrate		Magnesium Sulfate		Sodium Sulfate	
	A	S	A	S	A	S
0.25	---	---	---	---	0.4394	0.4450
0.5	0.4460	0.4590	0.3814	0.3852	.3735	.3804
1.0	.3900	.4102	.2948	.2992	.2781	.2872
1.5	---	---	---	---	.2073	.2175
2.0	.3015	.3316	.1658	.1708	---	---
3.0	.2375	.2736	---	---	---	---

SOLUBILITY OF CARBON DIOXIDE IN SODIUM CHLORIDE SOLUTIONS

(Harned and Davis, 1943)

The values listed below were read by the authors from a smoothed plot of their data. The results are higher in all cases than those of Markham and Kobe, 1941 and those of other workers (Vol. I, p. 221) the results are expressed in terms of grams of carbon dioxide dissolved in 1000 gms. of solvent.

Temp.	Gram Moles NaCl per 1000 gms. Water					
	0.0	0.2	0.5	1.0	2.0	3.0
0°	3.383	3.202	2.951	2.585	2.029	1.640
5°	2.818	2.673	2.470	2.174	1.722	1.399
10°	2.367	2.247	2.079	1.835	1.469	1.201
15°	2.007	1.905	1.765	1.569	1.263	1.043
20°	1.727	1.641	1.525	1.357	1.103	0.915
25°	1.514	1.444	1.344	1.200	0.979	0.816
30°	1.327	1.267	1.182	1.053	0.867	0.727
35°	1.179	1.127	1.054	0.948	0.781	0.654
40°	1.053	1.010	0.946	0.851	0.701	0.589
45°	0.964	0.920	0.921	0.771	0.636	0.533
50°	0.868	0.831	0.779	0.702	0.578	0.483

The solubility of carbon dioxide in water and in calcium chloride solutions at 75°, 100°, and 120° at pressures up to 700 atmospheres was determined by Prutton and Savage (1945). The results are expressed in terms of the mole fraction of carbon dioxide in the solution at each temperature and pressure. 10%, 20%, and 30% calcium chloride solutions were used.

Buch (1910) determined the partial pressures of carbon dioxide and ammonia over solutions containing ammonium carbonate and ammonium carbamate in varying proportions.

The partial pressures of carbon dioxide, ammonia, and water were determined over solutions of ammonium. chloride + ammonium sulfate (Belopolsky, Shpunt, and Palkina, 1941), and over $Cu(NH_3)_4^{++}$ solutions (Zhavoronkov, 1939).

SOLUBILITY OF CARBON DIOXIDE IN SOLUTIONS OF SULFURIC ACID AND PERCHLORIC ACID AT 25°

(Markham and Kobe, 1941a)

α = cc of CO_2 (measured at 0°, 760 mm) dissolved in 1 cc of water
S = cc of CO_2 (measured at 0°, 760 mm) dissolved in that volume of solvent which contains one gram of water.
The partial pressure of CO_2 was 760 mm in each determination

Gm. Moles H_2SO_4 per 1000 gms. H_2O	Gms. H_2SO_4 per 1000 gms. H_2O	α	S	Gm. Moles $HClO_4$ per 1000 gms. H_2O	Gms. $HClO_4$ per 1000 gms. H_2O	α	S
0.0	0.0	0.7565	0.7587	0.0	0.0	0.7565	0.7587
0.5	49.04	.6983	.7127	.25	25.12	.753	.764
1.0	98.08	.6650	.6911	.50	50.23	.759	.778
2.0	196.16	.6132	.6610	.75	75.35	.765	.793
3.0	294.24	.5854	.6546	1.00	100.47	.772	.809
4.0	392.32	.5740	.6659	1.50	150.70	.785	.840
6.0	588.48	.5878	.7332	2.00	200.94	.798	.865
8.0	784.64	.6159	.8238	4.00	401.88	.835	.984
10.0	980.8	.6337	.9053	6.00	602.82	.863	1.091
14.15	1387.8	.6404	1.0372	10.00	1004.7	.866	1.239
18.86	1849.8	.6225	1.1453	15.47	1554.3	.762	1.264
28.29	2774.7	.5840	1.3386	22.84	2294.7	.718	1.426
37.72	3699.6	.5659	1.5573				
56.58	5549.	.5741	2.1232				
94.30	9249.	.645					
188.6	18498.	.753					
282.9	27747.	.813					
565.8	55494.	.880					
1131.6	110987.	.920					
		.960					

SOLUBILITY OF CARBON DIOXIDE + AIR IN ACID SULFATE SOLUTION

(Kobe and Kenton, 1938)

See note on page 89 . The solubilities of the following mixtures were determined at 25°. The partial pressure of the gas was 760 mm.

Gas Dissolved	λ	β
CO_2	0.270	0.247
Air	.0053	.0049
Air + 5% CO_2	.0135	.0124
Air + 10% CO_2	.0235	.0215
79.4% N_2 + 6.1% O_2 + 14.5% CO_2	.0310	.0284
Air + 20% CO_2	.0447	.0410

The liquid-vapor equilibrium of the system $CO_2 + H_2O + K_2O + SiO_2$ was determined at 500° by Morey and Fleischer (1940). The distribution of CO_2 between liquid and vapor is reported as a function of pressure and solution composition.

Wolf and Krause (1927) determined the solubility of Carbon Dioxide in solutions of $CaCl_2$ + NaCl and HCl + H_2SO_4 to test their efficiency as sealing fluids for gas research.

SOLUBILITY OF CARBON DIOXIDE IN METHANOL

(Krichevskii and Lebedeva, 1947)

Cm^3 of carbon dioxide measured at 0°, 760 mm dissolves in 1 gm. of methanol.

Pressure atm.	0°	25°	49.8°	75°
6.8	59.5	29.9	19.5	12.8
10.7	94.9	49.3	32.1	22.3
16.5	174	82.5	51.8	35.5
22.3	270	118	71.9	48.6
30.0		197	112	71.5
39.7		287	161	103
49.4			228	140
55.2			269	-
59.4				181
68.8				234

SOLUBILITY OF CARBON DIOXIDE IN WATER AND ALCOHOL

(Bunsen, 1877; Henrich, 1892; Prytz and Holst, 1895)

Bunsen's data was interpolated by Henrich by using the method of least squares, and he obtained equations which expressed the solubility more closely than did Bunsen's equations. Prytz and Holst measured the solubility of CO_2 in water at 0°, and obtained the value 1.7308 cc per cc of water at 760 mm pressure. This agrees with Henrich's calculated results, but not with Bunsen's original extrapolated value of 1.7967. The values below were calculated from Henrich's equation, but are larger than those found by later workers. The solubility in ethyl alcohol has also been calculated using Henrich's equation. The equations are:

CO_2 in H_2O $\quad \alpha\ (\pm 0.012) = 1.7326 - 0.066724t + 0.0012394t^2$

CO_2 in Alcohol $\quad \alpha\ (\pm 0.005) = 4.3294 - 0.094261t + 0.0012394t^2$

Where α is the solubility in terms of the Bunsen coefficient and t = °C.

Temp	0°	5°	10°	15°	20°	25°
α Water	1.733	1.453	1.189	1.098	0.982	0.850
α Alcohol	4.329	3.899	3.510	3.194	2.938	2.7450

SOLUBILITY OF CARBON DIOXIDE IN ALCOHOL SOLUTIONS

(Roche, 1948)

L = Liters CO_2 dissolved in 1 liter of "liquid studied"

% Alcohol	Temp	L	% Alcohol	Temp	L
94.6	2°	1.66	94.6	62°	0.15
	15°	1.16	50	17°	.54
	42°	1.10	10	17°	.44
	42°	0.43	0	17°	.42

SOLUBILITY OF CARBON DIOXIDE IN ETHANOL

(Carius, 1855)

Absolute alcohol, sp. gr. = 0.792 at 20° was used. See Vol. I, p. 230-5

Temp.	α	Temp.	α
0°	3.59	15°	2.88
5°	3.32	20°	2.71
10°	3.09	25°	2.58

SOLUBILITY OF CARBON DIOXIDE IN ALCOHOL - WATER SOLUTIONS AT 25°

(Kobe and Mason, 1946)

A = Solubility of CO_2 in ml (measured at 25°, 760 mm) per ml. of original solution.
B = Solubility of CO_2 in ml (measured at 0°, 760 mm) per ml. of original solution.

Substance Added	Concentration Wt.%	A	B
None		0.823	0.754
Glycerol	40	.592	.542
Ethylene Glycol	60	.627	.574
"	40	.654	.599
"	20	.726	.666
Dioxane	60	1.523	1.395
dihydroxy-ethyl ether	60	0.633	0.579
Tetrahydrofurfural Alcohol	75	1.113	1.020

SOLUBILITY OF CARBON DIOXIDE IN CARBON DISULFIDE

(Woukoloff, 1889)

The author gives data for the solubility of carbon dioxide in carbon disulfide at two pressures of carbon dioxide at each of three temperatures. The data below was extrapolated to 760 mm of carbon dioxide and converted to a total pressure by adding the vapor pressure of carbon disulfide at each temperature. α = cc of CO_2 (measured at 0°, 760 mm) dissolved in 1 cc of CS_2.

Temp.	α at 760 mm CO_2	α at 760 mm Total Pressure	Temp.	α at 760 mm CO_2	α at 760 mm Total Pressure
0°	1.51	1.30	20°	1.25	0.90
5°	1.44	1.20	25°	1.19	0.81
10°	1.38	1.09	30°	1.13	0.72
15°	1.32	0.99			

SOLUBILITY OF CARBON DIOXIDE IN CHLOROFORM AT 13°

(Woukoloff, 1889a)

The results are given in terms of the "coefficient of dissolution" which is probably the Bunsen adsorption coefficient. The values were interpolated from the data given by the author. The solubility is strictly proportional to the pressure.

Pressure mm.	α	Pressure mm.	α
50.0	0.279	450.0.	2.591
100.0	0.565	500.0	2.881
150.0	0.859	550.0	3.168
200.0	1.145	600.0	3.454
250.0	1.436	650.0	3.747
300.0	1.716	700.0	4.046
350.0	2.069	750.0	4.360
400.0	2.305	760.0	4.425

A very careful determination by Horiuchi (1931) showed the solubility of carbon dioxide in carbon tetrachloride to be 2.668 ml. CO_2 (measured at 25°, 760 mm) per ml CCl_4 at 760 mm total pressure.

SOLUBILITY OF CARBON DIOXIDE IN LIQUID OXYGEN AND NITROGEN

(Federove, 1940)

Temp. °K	Mole Fraction CO_2 in Liquid: Oxygen	Nitrogen
67.0°	1.77×10^{-6}	2.21×10^{-6}
78.4°	2.91×10^{-6}	3.47×10^{-6}
98 °	5.61×10^{-6}	7.26×10^{-6}

SOLUBILITY OF CARBON DIOXIDE IN MIXTURES OF LIQUID OXYGEN + NITROGEN

(Ishkin and Burbo, 1939)

Vol.% O_2 in Solvent	Temp. °K	cc. CO_2 (0°, 760 mm) per liter of Solution	Mole Fraction CO_2 in Solution
99.6	90.0°	3.6	0.0000045
80.0	85.6°	2.8	.0000037
50.0	81.4°	2.1	.0000030
30.0	79.4°	1.85	.0000028
0.0	77.4°	1.49	.0000025

The liquid-vapor equilibrium in the systems $CO_2 + N_2$ (0°), $CO_2 + H_2$ (25°) and $CO_2 + CO$ (0°, 10°) are given in the form of diagrams by Abdulaev, 1939.

The pressure-composition diagram for the system $CO_2 + H_2S$ is given by Steckel, 1945.

P-V-T data at the critical point has been reported for the following systems:

$CO_2 - H_2$	Vershaffelt, 1899
$CO_2 - N_2$	Andrews, 1882
$CO_2 - O_2$	Keesom, 1903, 1903a, 1904
$CO_2 - HCl$	Ansdell, 1882
$CO_2 - N_2O$	Caubet, 1904
$CO_2 - SO_2$	Caubet, 1902
$CO_2 - C_2H_2$	Kuenen, 1897
$CO_2 - C_2H_6$	Kuenen, 1897, 1897a; Kuenen and Robson, 1902
$CO_2 - CH_3Cl$	Kuenen, 1892, 1897; Caubet, 1904
$CO_2 - C_6H_5NO_2$	Kohnstamm and Reeders, 1912
CO_2 - Air	Cailletet, 1880

THE SYSTEM $CO_2 - H_2O$: SOLUBILITY OF WATER IN LIQUID CARBON DIOXIDE

(Stone, 1943)

Each value is an average of several determinations

Temp.	Wt.% H_2O
-29°	0.020
+ 5.08°	.064
+15.0°	.090
+22.6°	.104

The mutual solubility of carbon dioxide and ethylene at 0° and pressures up to 7000 Kg/cm^2 has been studied by Tsiklis, 1947a.

SOLUBILITY OF CARBON DIOXIDE IN BENZENE

(Wan and Dodge, 1940)

The solubility of carbon dioxide in benzene was determined at various temperatures and pressures in an all metal cylinder immersed in an oil bath. The temperature was carefully controlled, and benzene of boiling point 79.9° - 80.1° was used. The authors give graphs showing the mole fraction of carbon dioxide in the liquid and in the vapor, and the Henry's law constants are tabulated. The solubilities in terms of grams of carbon dioxide per gram of benzene were calculated from the author's graphs. The data do not agree with those of Sandor (Vol. I, p. 234).

$$K = \frac{\text{Total pressure} \times \text{mole fraction } CO_2 \text{ in vapor}}{\text{Mole fraction } CO_2 \text{ in liquid}}$$

Mole Fraction CO_2 in Liquid	Henry's law constants (K) 30°	40°	50°	60°
0.10	1240	1420	1670	1850
.20	1230	1430	1650	1918
.30	1208	1440	1605	1940
.40	1190	1395	1605	1935
.50	1169	1360	1588	1910
.60	1102	1303	1535	1840
.70	1045	1255	1492	1742

A = Grams carbon dioxide dissolved per gram of benzene
B = Mol % carbon dioxide

Total Pressure Lbs. per sq. inch	30° A	30° B	40° A	40° B	50° A	50° B	60° A	60° B
100	0.048	7.8	0.039	6.5	0.035	5.8	0.030	5.0
200	.108	16.0	.090	13.7	.073	11.5	.063	10.0
300	.183	24.5	.145	20.5	.120	17.5	.093	15.0
400	.275	32.8	.214	27.3	.175	23.7	.141	20.0
500	.392	41.0	.298	34.6	.247	30.5	.188	25.0
600	.581	50.5	.416	42.5	.322	36.7	.242	30.0
700	.960	63.0	.587	51.0	.422	42.8	.310	35.5
800	1.91	77.2	.846	60.0	.552	49.5	.383	40.5
900	3.91	87.4	1.315	70.0	.719	56.5	.471	45.5
1000	15.55	96.5	2.500	81.6	1.049	65.0	.598	51.5
1100					1.520	73.0	.772	57.8
1200					3.19	85.0	.845	66.0
1300							1.762	75.8
1400							2.328	88.5

The pressure - volume - composition relationships for the liquid - vapor equilibria in the systems Carbon Dioxide - Ethane, Carbon Dioxide - Propane, Carbon Dioxide - Butane, and Carbon Dioxide - Pentane have been determined by Poettman and Katz (1945) from room temperature to the critical temperature.

Liquid - vapor equilibrium data in the system CO_2 + n - Butane from 100° F to 460° F at pressures up to 10,000 lbs/sq. in. are given by Olds, Reamer, Sage, and Lacey, 1941.

At 170° and 50 atmospheres pressure, 2.9 cc of Carbon Dioxide (measured at 0°, 1 atm.) dissolve in 1 gm. of Polystyrene. (Newitt and Weale, 1948).

SOLUBILITY OF CARBON DIOXIDE IN HYDROCARBONS AT 40°

(McCay, Seeley, and Gardner, 1941)

The solubility in each hydrocarbon and in 5% NaCl solution was determined and the distribution ratios between the organic and aqueous phases were calculated at each pressure. (Solubilities at 5 atm intervals are also given)

Pressure Atm (absolute)	Gms. CO_2 per gm. of Hydrocarbon or gm. of 5% NaCl solution					
	Pentane C_5H_{12}	5% NaCl	Benzene C_6H_6	5% NaCl	Decahydronaphthalene $C_{10}H_{18}$	5% NaCl
10	0.1430	0.00685	0.0322	0.00730	0.0280	0.0100
20	.2480	.00985	.0969	.01298	.0600	.0160
30	.3870	.01310	.1932	.01651	.0900	.0219
40	.4500	.01725	.3220	.01932	.1200	.0275
50	.6420	.02130	.5470	.02402	.1520	.0325
60			1.1910	.03415	.2040	.0368
70					.3020	.0400

	Cyclohexane C_6H_{12}	5% NaCl	Hexadecane $C_{16}H_{24}$	5% NaCl
10	0.0652	0.0110	0.0800	0.0094
20	.1312	.0154	.1580	.0150
30	.1895	.0179	.2260	.0188
40	.2395	.0206	.2810	.0215
50	.2900	.0236	.3330	.0245
60	.3500	.0266	.3930	.0283
70	.4130	.0284	.4700	.0329
80	.5310	.0272	.6900	.0290

SOLUBILITY OF CARBON DIOXIDE IN FATS

(Schaffer and Haller, 1943)

Ml of gas (0°, 760 mm) per 1000 ml of fat

	40°	60°
Butter oil	109.5	91.0
Cottonseed oil	87.6	--
Lard	100.3	

CS CARBON OXYSULFIDE COS

SOLUBILITY OF CARBON OXYSULFIDE IN OIL AT 32°

(Avdeeva and Pitelina, 1947)

Note:

The solubility was measured in "solar oil" (petroleum) having the following physical properties: Molecular wt. 230; density 0.8768; initial boiling point 215°C; viscosity (Engler) 20° - 171, 50° - 128; flash pt. 108°. The data were read from graphs given by the authors, and the points lie on a straight line.

Volume % COS in gas	Gms. COS per liter of oil
10	1.4
20	2.9
30	4.4
40	5.8
50	7.3
60	8.8

CARBON DISULFIDE CS_2 See also page 571 S

SOLUBILITY OF CARBON DISULFIDE IN OIL

(Avdeeva and Pitelina, 1947)

NOTE:

The solubility was measured in "Solar Oil" (petroleum) having the following properties: Molecular weight: 230; density 0.8768; initial boiling point 215° C; viscosity (Engler) 20°-171, 50°-128; flash point 108°. The data were read from graphs drawn by the authors, and the points lie on straight lines at each temperature. The effect of varying the molecular weight of the oil was also studied.

Grams CS_2 per liter of Oil

Gms. CS_2 per cubic meter of gas:		40	120	200	280	360	440
Temp.	20°	7.9					
	30°	6.0	18.0				
	60°	2.2	6.6	11.1	15.5	19.8	24.2
	100°	0.8	2.2	3.6	5.1		

The solubility of Carbon Disulfide in blood was determined by McKee, 1941.

The system Carbon Disulfide + Methyl Alcohol + Oleic Acid + Olive Oil is reported by Moreno and Gonzalez, 1948.

The following systems have been studied:

CS_2 + Benzene (Vapor pressures at 25°)
CS_2 + Diethyl Ether (Vapor pressures at 19°) } Horiuchi, 1931

CS_2 + Methyl Acetate (Upper critical solution temperature: -52.6°, 61 mole % CS_2) Clusius and Ulmke, 1941.

CS_2 + Acetone (Upper critical solution temperature: -51.4°, 66 mole % CS_2) Clusius and Ringer, 1940.

CALCIUM Ca

Ca

The system Ca - $CaCl_2$ was studied by Cubicciotti and Thurmond, 1949. The substances are only partially miscible as liquids.

The melting point of the eutectic mixture in the system Ca + NH_3 is about -90°. (Birch and MacDonald, 1947).

CALCIUM ALUMINATES $xCaO \cdot yAl_2O_3 + n\ H_2O$ See also page 39. Al0

The system $CaO - Al_2O_3 - H_2O$ has been studied in detail by Wells, Clarke, and McMurdie, 1943 at 21° and 90°. Only three stable phases were found over this range of temperature: $Al_2O_3 \cdot 3H_2O$, $3CaO \cdot Al_2O_3 \cdot 6H_2O$, and $Ca(OH)_2$. $2CaO \cdot Al_2O_3 \cdot 8H_2O$ and $4CaO \cdot Al_2O_3 \cdot 13\ H_2O$ were found to exist metastably and to form a 1:1 compound.

The system $CaO + Al_2O_3 + TiO_2 + H_2O$ is discussed, and the known hydrates tabulated, by Bessey, (1938).

AsO **CALCIUM ARSENITE** $xCaO{\cdot}yAs_2O_3 + nH_2O$

Guerin and Masson (1949) studied the system $CaO - As_2C_3 - H_2O$ at 60° and found the same compounds as did Story and Anderson (Vol. I, p. 241):

In contact with solutions containing 0.09% - 4.8% As_2O_3 : $CaO{\cdot}As_2O_3$
" " " " " 0.022% - 0.08% CaO : $2CaO{\cdot}As_2O_3{\cdot}nH_2O$

AsO **CALCIUM ARSENATES** $xCaO \cdot yAs_2O_5 + nH_2O$

THE SYSTEM $CaO - As_2O_5 - H_2O$

(Guerin, 1941a)

The system has been investigated by many authors (Vol. I, p. 241,2), and in general there is good agreement as to the proportions of CaO and As_2O_5 in the solid phases, but the degree of hydration is still uncertain in many cases. The table below summarizes the results of the various authors, including Guerin, and shows the number of molecules of water assigned by each author to the compounds found by him. An x indicates that the compound was found, but the degree of hydration was not determined, and a (-) indicates that the compound was not found. Eisenberger, Lehrman, and Turner (1940) think that the continuous solid solutions exist in the basic region, rather than the 3:1, 10:3, and 4:1 compounds.

$CaO:As_2O_5$	Tartar, Wood, and Hiner (1924)	Smith (1920)	Fearce and Avens (1937)	Nelson and Haring (1937)	Fearce and Norton (1936)	Guerin (1941)			
	25°	35°	35°	62°	90°	17°	40°	60°	90°
1:1	-	2	-	2	-	2	2	2	0,2
2:1	-	3	x	1	x	3,5	3,5	3	1,3
5:2	-	-	x	6	x	10	5	5	5
3:1	-	-	x	2	x	10	4	2	2
10:3	x	-	-	-	x	-	-	-	-
4:1	-	-	-	x	-	5	1	1	1

In order to obtain equilibrium, Guerin shook CaO + As_2O_5 and distilled water together for several hours in a thermostat constant to ± 2°. Occasionally one of the suspected compounds was used to prepare the original mixtures. Analyses were made of the wet residues or the dried crystals after equilibrium was attained. The results agree well with those of Nelson and Haring (1937).

ISOTHERMAL INVARIANT POINTS IN THE SYSTEM $CaO - As_2O_5 - H_2O$ AsO

(Guerin, 1941)

	pH	Solution Wt. % CaO	Solution Wt. % As_2O_5	Solid Phases ($CaO:As_2O_5:H_2O$)
17°	2.4	6.5	27.5	1:1:2 + 2:1:3 (2:1:5?)
	6.8	0.09	0.32	2:1:3 + 5:2:10
	7.8	.05	.10	5:2:10 + 3:1:10
	9.6	.04	Trace	3:1:10 + 4:1:5
40°	2.4	6.6	28.5	1:1:2 + 2:1:3 (2:1:5?)
	6.4	0.09	0.23	2:1:3 + 5:2:5
	7.4	.03	.06	5:2:5 + 3:1:4
	9.0	.006	.008	3:1:4 + 4:1:1
60°	2.4	6.7	29.7	1:1:2 + 2:1:3
	6.2	0.07	0.2	2:1:3 + 5:2:5
	6.8	.03	.07	5:2:5 + 3:1:2
	7.8	.008	.017	3:1:2 + 4:1:1
90°	2.4	6.8	32.0	(1:1:0) 1:1:2 + 2:1:1 (2:1:3?)
	5.9	0.06	0.22	2:1:1 + 5:2:5
	6.2	.02	.07	5:2:5 + 3:1:2
	8.0	.009	.017	3:1:2 + 4:1:1

CALCIUM BORATE CaB_2O_4 BO

THE SYSTEM $CaO - B_2O_3 - H_2O$ at 25°

(Nikolaev and Chelishcheva, 1940)

The authors found the same compounds in the system as did Sborgi (Vol. I, p. 242), but with different degrees of hydration. Mixtures of the oxides were allowed up to three months to attain equilibrium, rather than 5 days (Sborgi). The data show considerably smaller solubilities than previously.

Gms. per 100 gms. Saturated Solution		
CaO	B_2O_3	Solid Phase
0.119	0.0	$Ca(OH)_2$
.190	.102	$Ca(OH)_2 + CaO \cdot B_2O_3 \cdot 6H_2O$
.175	.104	$CaO \cdot B_2O_3 \cdot 6H_2O$
.090	.126	$CaO \cdot B_2O_3 \cdot 6H_2O + 2CaO \cdot 3B_2O_3 \cdot 13H_2O$
.034	.380	$2CaO \cdot 3B_2O_3 \cdot 13H_2O$
.053	.955	$2CaO \cdot 3B_2O_3 \cdot 13H_2O + CaO \cdot 3B_2O_3 \cdot 4H_2O$
.044	1.34	$CaO \cdot 3B_2O_3 \cdot 4H_2O$
.058	3.30	$CaO \cdot 3B_2O_3 \cdot 4H_2O + H_3BO_3$
0.0	3.17	H_3BO_3

Br CALCIUM BROMIDE $CaBr_2$

EQUILIBRIUM IN THE SYSTEM CALCIUM BROMIDE - INDIUM BROMIDE - WATER AT ROOM TEMPERATURE

(Ensslin, Ziemeck, and deSchaepdryver, 1947)

Gms. per 100 ml. Sat. Sol.		Solid Phase	Gms. per 100 ml. Sat. Sol.		Solid Phase
$InBr_3$	$CaBr_2$		$InBr_3$	$CaBr_2$	
184.4	17.0	$CaBr_2 \cdot 2InBr_3 \cdot 8H_2O$	53.4	82.2	$CaBr_2 \cdot InBr_3 \cdot 8H_2O$
180.1	20.0	"	47.3	83.4	$3CaBr_2 \cdot 2InBr_3 \cdot 23H_2O$
80.3	58.0	$CaBr_2 \cdot InBr_3 \cdot 8H_2O$	39.8	85.3	"
76.9	76.5	"	29.0	90.8	$2CaBr_2 \cdot InBr_3 \cdot 14H_2O$
61.8	78.0	"	26.4	93.8	"

C CALCIUM CARBIDE CaC_2

The melting points, densities, hardness and crystal structures of the system CaC_2 + CaO are given by Aall (1949).

CH CALCIUM ACETATE $Ca(C_2H_3O_2)_2$

The systems Calcium Acetate - Humic Acid - Water and Calcium Acetate - Methoxyhumic Acid - Water were studied by Fuchs, 1943.

CALCIUM CITRATE $Ca(C_6H_5O_7)_2 \cdot 4H_2O$

100 gms. Saturated Solution in Furfural contains 0.01 gms. at 25°. (Trimble, 1941).

CALCIUM ACETYLSALICYLATE $Ca(C_6H_4(OCOCH_3)COO)_2$

33.5% dissolved in ether after standing for 16 hours at room temperature
35.2% dissolved in Absolute Alcohol after standing for 3 hours at room temperature (Ebach, 1943).

CALCIUM 2, 4-DINITRO PHENATE $Ca[C_6H_3(NO_2)_2O]_2$
CALCIUM 2, 4-DINITRO CRESYLATE $Ca[C_6H_2(CH_3)(NO_2)_2O]_2$

Fabrac and Le Trivain (1948) (See note page 66)

At 15° between 1.0 and 2.0 wt. % Calcium 2, 4-Dinitro Cresylate dissolve in water
At 4° " .5 and 1.0 " Calcium 2, 4-Dinitro Phenate " " "
At 15° " 1.0 and 2.0 " " " " " "

CALCIUM TETRACHLORO PHTHALATE $CaC_6Cl_4(COO)_2$

100 gms. of a saturated solution of the salt in water contains 0.07 gms. at 24° (Lawlor, 1947).

CALCIUM DODECYL SULFATE $Ca(C_{12}H_{25}SO_4)_2$

SOLUBILITY IN SOLUTIONS OF SODIUM DODECYLSULFATE AT 50°
(Tarter and Cadle, 1939)

Gms. per 100 gms. H_2O	
NaD	CaD
0.0	0.261
.200	1.25
.600	2.60
1.250	4.30
2.500	7.27

CALCIUM DODECYLSULFONATE $Ca(C_{12}H_{25}SO_3)_2$

SOLUBILITY IN SOLUTIONS OF SODIUM DODECYISULFONATE AT 50°
(Tarter and Cadle, 1939)

Gms. per 100 gms. H_2O			
NaD	CaD	NaD	CaD
0.0	0.0220	1.5000	0.135
.0125	.0166	2.5000	.171
.0300	.0067	5.000	.260
.1000	.0028	10.000	.440
.2000	.0043	15.000	.820
.6000	.0260		

CALCIUM ANTHRACENE SULFONATES $Ca(C_{14}H_9SO_3)_2$ $CaC_{14}H_8S_2O_6$

CH

SOLUBILITY IN WATER AT 20° AND 100°
(Federov and Lodygin, 1942)

	Gms. of Salt per 100 gms. Sat. Sol.	
	20°	100°
α - $Ca(C_{14}H_9SO_3)_2 \cdot 3H_2O$	0.0266	0.3286
β - $Ca(C_{14}H_9SO_3)_2 \cdot H_2O$	.0162	.1034
1, 5 - $C_{14}H_8S_2O_6Ca \cdot 3H_2O$	.2666	.5248
1, 8 - $C_{14}H_8S_2O_6Ca \cdot 5H_2O$	.1840	.3544
2, 6 - $C_{14}H_8S_2O_6Ca \cdot 5H_2O$	.2424	.4425
2, 7 - $C_{14}H_8S_2O_6Ca \cdot 3H_2O$	.1072	.2107

EQUILIBRIUM IN THE SYSTEM CALCIUM THIOCYANATE - POTASSIUM THIOCYANATE - WATER AT 25°

(McKerrow, Occlesshaw, and Drabble, 1946)

Calcium Thiocyanate Tetrahydrate exists in two forms: An α form stable above 23.8° and a β form stable below this temperature (See page 12).

Gms. KCNS per 100 gms. Sat. Sol.	Gms. $Ca(CNS)_2$ per 100 gms. Sat. Sol.	Solid	Gms. KCNS per 100 gms. Sat. Sol.	Gms. $Ca(CNS)_2$ per 100 gms. Sat. Sol.	Solid
70.76	0.0	A	24.00	46.65	C
66.16	4.01	A	18.62	51.82	C
59.32	10.51	A	17.77	53.18	C + α-D
53.38	16.78	A	*21.32	52.10	α-D
49.34	21.41	A	17.54	53.19	"
45.57	26.61	A	13.81	54.39	"
44.09	29.16	A	10.46	55.68	"
43.75	31.39	A	7.90	56.67	"
43.77	32.21	A + B	5.23	57.71	"
43.56	31.66	B	2.10	58.99	"
42.84	32.11	B	0.0	60.20	"
42.07	32.81	B	*13.76	54.56	β-D
41.12	33.69	B	*10.56	55.89	"
40.22	34.22	B	* 6.40	57.63	"
39.06	35.22	B	* 4.68	58.60	"
36.89	37.18	B	* 2.77	59.55	"
36.28	37.47	B + C	* 0.0	61.10	"
*34.17	39.59	B	* 0.0	60.75	"
*33.53	40.00	B	*43.75	33.61	A + E
*31.50	41.61	B	*41.83	35.31	E
*43.88	32.56	A + C	*40.38	36.34	E
*42.81	33.38	C	*36.74	39.52	E
*41.91	34.61	C	*32.60	43.96	E
*38.80	36.01	C	*29.05	48.50	E
35.39	37.95	C	*28.30	49.57	E + F
32.56	40.17	C	*28.49	49.20	F
26.55	44.66	C	*25.26	50.82	F
			*23.46	52.14	β-D + F

A = KCNS

B = $3KCNS \cdot Ca(CNS)_2 \cdot 3H_2O$

C = $2KCNS \cdot Ca(CNS)_2 \cdot 3H_2O$

α, β-D = $Ca(CNS)_2 \cdot 4H_2O$

E = Solid Solution Approaching $4KCNS \cdot Ca(CNS)_2 \cdot 2H_2O$

F = $Ca(CNS)_2 \cdot 2H_2O$

* = Metastable

EQUILIBRIUM IN THE SYSTEM CALCIUM THIOCYANATE - SODIUM THIOCYANATE - WATER AT 25°

(McKerrow, Occlesshaw, and Drabble, 1946)

Gms. NaCNS per 100 gms. Sat. Sol.	Gms. $Ca(CNS)_2$ per 100 gms. Sat. Sol.	Solid Phase	Gms. NaCNS per 100 gms. Sat. Sol.	Gms. $Ca(CNS)_2$ per 100 gms. Sat. Sol.	Solid Phase
58.78	0.0	$NaCNS \cdot 2H_2O$	29.32	32.45	NaCNS
52.08	7.19	"	22.40	39.91	"
45.37	15.97	"	21.32	41.06	"
42.98	19.00	"	19.57	43.27	"
42.90	19.09	$NaCNS \cdot 2H_2O$ + NaCNS	16.36	46.46	"
*62.42	0.0	NaCNS	14.14	49.67	"
*51.47	10.43	"	11.15	53.03	"
*50.58	11.50	"	11.10	53.52	"
*43.83	18.14	"	9.88	54.48	$NaCNS + Ca(CNS)_2 \cdot 4H_2O$
41.74	20.59	"	8.78	55.11	$Ca(CNS)_2 \cdot 4H_2O$
38.82	23.13	"	5.11	57.57	"
37.91	24.07	"	3.09	58.49	"
32.38	29.71	"	0.0	60.20	"

*Metastable

CNS

EQUILIBRIUM IN THE SYSTEM CALCIUM THIOCYANATE - AMMONIUM THIOCYANATE - WATER AT 25°

(McKerrow, Occlesshaw, and Drabble, 1946)

Gms. NH_4CNS per 100 gms. Sat. Sol.	Gms. $Ca(CNS)_2$ per 100 gms. Sat. Sol.	Solid Phase	Gms. NH_4CNS per 100 gms. Sat. Sol.	Gms. $Ca(CNS)_2$ per 100 gms. Sat. Sol.	Solid Phase
64.33	0.0	NH_4CNS	28.15	46.24	$4NH_4CNS \cdot Ca(CNS)_2 \cdot 2H_2O$
57.85	7.29	"	26.87	47.29	"
49.18	16.70	"	25.95	49.07	"
42.72	23.62	"	25.50	49.89	$4NH_4CNS \cdot Ca(CNS)_2 \cdot 2H_2O$ +
40.38	27.52	"	25.55	50.13	$7NH_4CNS \cdot 6Ca(CNS)_2 \cdot 12H_2O$
37.84	34.00	"	24.45	50.99	$7NH_4CNS \cdot 6Ca(CNS)_2 \cdot 12H_2O$
37.67	37.01	$NH_4CNS + 4NH_4CNS \cdot Ca(CNS)_2 \cdot 2H_2O$	23.31	51.62	"
			21.38	52.76	"
36.98	37.36	$4NH_4CNS \cdot Ca(CNS)_2 \cdot 2H_2O$	20.55	53.26	"
35.04	39.04	"	18.40	53.95	"
34.35	39.49	"	*16.91	55.22	"
34.13	40.19	"	17.32	55.64	$7NH_4CNS \cdot Ca(CNS)_2 \cdot 12H_2O$ + $Ca(CNS)_2 \cdot 4H_2O$
32.89	41.58	"			
31.48	43.22	"	15.23	55.11	$Ca(CNS)_2 \cdot 4H_2O$
31.37	43.29	"	9.29	57.14	"
29.04	45.33	"	0.0	60.20	"

*Metastable

CALCIUM CARBONATE $CaCO_3$

CO

Wesley (1944) found the solubility of Calcium Carbonate in water free of Carbon Dioxide to be 13 mg. per liter at room temperature, and 24 mg. per liter at 95°.

Bountine and Bykof (1935) showed that considerably more Bicarbonate exists in the system $CaCO_3 + K_2SO_4 + CO_2 + H_2O$ than in the system $CaCO_3 + CO_2 + H_2O$ because of the reaction $Ca(HCO_3)_2 + K_2SO_4 \rightleftharpoons 2KHCO_3 + CaSO_4$.

Greenwald (1945) showed that the solubility of Calcium Carbonate is increased by the presence of Calcium Phosphate. He presents data at constant ionic strength with varying amounts of Phosphate and varying pH.

The pH of solutions containing varying amounts of CO_2, HCO_3^- and H_2CO_3.

At 25° a saturated solution of $CaCO_3$ in water contains 5.80 mg. CO_2 per liter (13.2 mg. $CaCO_3$ per liter). (Franquin and Marecaux, 1938).

The solubility product of $CaCO_3$ in beet juices was determined by Dedeck (1946).

The solubility of $CaCO_3$ in tropical sea water is given by Smith (1941).

CO

THE SYSTEM $CaCO_3 - CaSO_4 - NaCl - CO_2 - H_2O$ AT 25°

(Shternina and Frolova, 1945)

The system was studied at two pressures of Carbon Dioxide with varying amounts of NaCl added. The solid phases were always $CaCO_3$ (Calcite) or $CaSO_4 \cdot 2H_2O$ (Gypsum), or a mixture of the two.

Solid Phase	Gms. $Ca(HCO_3)_2$ per 1000 gms. H_2O	Gms. $CaSO_4$ per 1000 gms. H_2O	Gms. NaCl per 1000 gms. H_2O	Partial Pressure CO_2 (Atm.)	Density d_4^{25}
Calcite	1.478	0.0	0.0	0.9555	0.9989
"	1.621	0.0	2.500	.9639	1.007
"	1.723	0.0	5.027	.9593	1.0026
"	1.913	0.0	10.204	.9658	1.0065
"	2.073	0.0	15.000	.9645	1.0101
"	2.195	0.0	20.486	.9671	1.0141
Gypsum	0.0	2.091	0.0	.9632	0.9993
"	0.0	2.450	2.500	.9750	1.0013
"	0.0	2.916	5.001	.9777	1.0034
"	0.0	3.429	10.145	.9711	1.0077
"	0.0	3.884	15.002	.9750	1.0114
"	0.0	4.356	20.013	.9687	1.0153
Calcite + Gypsum	1.258	1.739	0.0	.9726	0.9999
" "	1.475	2.258	2.526	.9653	1.0023
" "	1.580	2.533	5.076	.9782	1.0044
" "	1.614	3.053	10.133	.9597	1.0084
" "	1.652	3.496	15.206	.9517	1.0124
" "	1.736	4.005	20.228	.9684	1.0165
Calcite	0.129	0.0	0.0	.0013	0.9968
Gypsum	0.0	2.096	0.0	"	0.9987
Calcite + Gypsum	0.040	2.244	0.0	"	0.9991
Calcite	0.194	0.0	10.278	"	1.0042
Gypsum	0.0	3.505	10.278	"	1.0074
Calcite + Gypsum	0.050	3.598	10.285	"	1.0071
Calcite	0.243	0.0	20.350	"	1.0113
Gypsum	0.0	4.414	20.125	"	1.0155
Calcite + Gypsum	0.061	4.509	20.085	"	1.0151

Melting points in the system $CaCO_3 + K_2CO_3$ are given by Kroger, Illner, and Graeser (1948).

100 gms. of Furfural Solution saturated with $CaCO_3$ at 25° contain 0.04 gms. $CaCO_3$ (Trimble, 1941).

CALCIUM OXALATE CaC_2O_4

SOLUBILITY OF CALCIUM OXALATE IN SOLUTIONS OF ELECTROLYTES AT 25°

(Kolthoff and Sandell, 1933)

The authors found the solubility of pure $CaC_2O_4 \cdot H_2O$ to vary with the amount of excess solid which was present at equilibrium. The "normal" solubility was measured (with a very slight excess of solid), and the amount of each ion in solutions containing an excess of solid was found to depend on the amount of ion exchange on the crystal surfaces.

Electrolyte	Concentration	"Normal" Solubility mmol per Liter		Solubility with 12 - 15 gms. $CaC_2O_4 \cdot H_2O$ per 250 cc excess: mmol. per Liter	
		Ca^{++}	$C_2O_4^{=}$	Ca^{++}	$C_2O_4^{=}$
H_2O	–	0.067	0.067	0.067	0.067
$(NH_4)_2SO_4$	0.01	.112	.115	.31	.05
NH_4IO_3	.01	.090	.090	.13	.058
$NaOH$	.01	.126	.126	.30	.052
$BaCl_2$	.001	.078	.078	.03	.21

THE SOLUBILITY OF CALCIUM OXALATE IN SALT SOLUTIONS

(Shebyn and Pall, 1940)

The authors stirred various amounts of $CaC_2O_4 \cdot H_2O$ in solution until equilibrium was attained, as shown by a constant amount dissolved. About 10 minutes of rapid stirring with an excess of solid were needed, and a longer time was needed with less stirring or smaller amounts of solid. The solutions were filtered and the temperature read just before filtering. At low temperatures the control was ± 0.5° and at higher temperatures ± 1°.

Added Salt	Gms. Added Salt per Liter of Solution	Mg. CaC_2O_4 per Liter of Solution				
		27.5°	28°	30°	50°	95°
None	0.0			8.27		14.5
Na_2SO_4	3		17.18		24.97	39.9
"	15		34.08		49.75	83.5
"	40		55.19		84.30	144.0
NH_4Cl	3	16.40			21.62	34.2
"	15	28.63			41.42	66.9
"	40	41.22			61.14	104.7
NH_4NO_3	3	14.66				
"	40	35.77				
"	80	46.49				
$(NH_4)_2SO_4$	3			21.5	28.85	47.5
"	15			42.4	56.8	
"	25					134.0
"	27.5			57.0		
"	40			71.5	97.8	
"	90			109.4	147.2	314.5

Data for the solubility of calcium oxalate in water and in solutions of NH_3, NH_4Cl and $(NH_4)_2C_2O_4$ were determined by Tananaev and Pochinok, 1932.

SOLUBILITY OF CALCIUM OXALATE IN SALT SOLUTIONS AT 25°

(McComas and Rieman, 1942)

CO The authors summarize the work of previous workers (Vol. I, p. 277-280, and above) on the solubility of Calcium Oxalate in water at 25° which range from 5.7 to 29.9 mg. CaC_2O_4 per liter of solution. Two preparations were used in the present work, one prepared from a solution containing an excess of Ca^{++} and the other from a solution with an excess of $C_2O_4^{=}$ ions. The solubility of each product was determined by agitation for an hour at 25.0 ± 0.2°. The average solubilities were found to be 5.71 and 5.94 mg. per liter respectively. The mean, 5.84 mg. per liter is in good agreement with many previous authors.

Added Salt	Gms. Added Salt per Liter of solution		Mg. CaC_2O_4 per Liter of Solution
	Mols	Grams	
None	0.0	0.0	5.84
NaCl	.100	5.85	15.1
"	.200	11.70	19.8
"	.300	17.55	22.6
"	.400	23.39	25.0
"	.500	29.23	27.0
"	.600	35.09	28.9
"	.700	40.9	30.5
"	.800	46.8	31.8
"	.900	52.6	33.4
"	1.000	58.5	34.7
KCl	0.64	47.7	29.5
$HCOONH_4$	.36	22.7	28.6
Na_2SO_4	.213	30.25	44.8

The solubility of Calcium Oxalate in solutions from pH 1.56 to 10.40, prepared by mixing 0.2 M H_3PO_4 with 0.2 M NaOH in varying proportions at 38° was determined by Hoover and Wijesinha, 1945. The data (reported in ml. of 0.01 N $KMnO_4$ used to titrate 100 ml. of saturated solution) show a minimum solubility at a pH of about 6, and the salt is much more soluble in the basic Phosphate Solutions than when excess acid is present. In other experiments, the presence of acetate and borate ions was found not to affect the solubility.

Cl CALCIUM CHLORIDE $CaCl_2$

THE SYSTEM CALCIUM CHLORIDE - WATER

(Yanatieva, 1946)

The author determined the ice curve and the solubility of $CaCl_2 \cdot 6H_2O$ down to the eutectic, which he reports to be -49.8°. The curves agree closely with those previously reported (Vol. I, p. 280), but deviate near the eutectic (-51.0° previous workers) where the temperature of freezing changes greatly with small changes in composition. This system was later used as part of Ternary Systems with $MgCl_2$ and NaCl (see below), and the temperature -49.8° is consistant with the freezing points found in the Ternary Mixtures.

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Temp.°	Solid Phase	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Temp.°	Solid Phase
43.48	22.0	$CaCl_2 \cdot 6H_2O$	30.48	-49.7	$CaCl_2 \cdot 6H_2O$
42.07	18.5	"	30.22	-49.8	$CaCl_2 \cdot 6H_2O$ + Ice
39.36	7.5	"	30.00	-47.7	Ice
36.00	-8.5	"	28.10	-40.7	"
32.41	-36.2	"	22.70	-23.2	"
31.91	-39.5	"	19.14	-16.5	"
31.29	-45.5	"	15.82	-11.2	"
30.82	-49.2	"			

Cl

THE SYSTEM CALCIUM CHLORIDE - MAGNESIUM CHLORIDE - WATER FROM -45° to +15°

(Yanatieva, 1946)

The author draws a diagram showing the phases present at all compositions and temperatures below + 45°, and presents data at both constant temperature and composition. The ternary eutectic occurs at -55.0° and was approached along two smooth curves. The agreement with other work (Vol. I, p. 288 - 289) is good.

Gms. per 100 gms. Saturated Solution		Solid Phase	Gms. per 100 gms. Saturated Solution		Solid Phase
$CaCl_2$	$MgCl_2$		$CaCl_2$	$MgCl_2$	
	Results at 15°			Results at 0°	
0.0	35.50	$MgCl_2 \cdot 6H_2O$	0.0	34.80	$MgCl_2 \cdot 6H_2O$
20.30	20.30	"	14.00	23.50	$MgCl_2 \cdot 6H_2O$ + $CaCl_2 \cdot 6H_2O$
22.60	18.40	$MgCl_2 \cdot 6H_2O$ + $CaCl_2 \cdot 6H_2O$	18.50	18.50	$CaCl_2 \cdot 6H_2O$
31.00	10.60	$CaCl_2 \cdot 6H_2O$	27.80	9.40	"
38.60	2.80	"	35.20	2.60	"
41.20	0.0	"	37.26	0.0	"
	Results at -5°			Results at -10°	
8.40	0.0	Ice	14.80	0.0	Ice
8.20	0.70	"	14.20	1.00	"
6.40	2.20	"	10.80	3.60	"
4.60	4.60	"	7.00	7.00	"
0.0	7.40	"	0.0	11.60	"
0.0	34.40	$MgCl_2 \cdot 6H_2O$	0.0	33.60	$MgCl_2 \cdot 8H_2O$
10.60	26.00	$MgCl_2 \cdot 6H_2O$ + $CaCl_2 \cdot 6H_2O$	10.40	25.40	$MgCl_2 \cdot 8H_2O$ + $CaCl_2 \cdot 6H_2O$
17.80	17.80	$CaCl_2 \cdot 6H_2O$	17.60	17.60	$CaCl_2 \cdot 6H_2O$
27.20	9.10	"	26.60	8.80	"
34.40	2.20	"	33.60	2.20	"
36.20	0.0	"	35.50	0.0	"

Gms. per 100 gms. Saturated Solution		Solid Phase
$CaCl_2$	$MgCl_2$	
Results at -15°		
18.50	0.0	Ice
17.20	1.20	"
13.20	4.40	"
8.50	8.50	"
0.0	14.60	"
0.0	32.60	$MgCl_2 \cdot 8H_2O$
10.78	24.21	$MgCl_2 \cdot 8H_2O + CaCl_2 \cdot 6H_2O$
17.40	17.40	$CaCl_2 \cdot 6H_2O$
26.00	8.60	"
32.80	2.10	"
34.50	0.0	"
Results at -20°		
21.00	0.0	Ice
20.00	1.30	"
15.00	5.00	"
9.60	9.60	"
0.0	16.80	"
0.0	26.60	$MgCl_2 \cdot 12H_2O$
17.20	17.20	$CaCl_2 \cdot 6H_2O$
25.40	8.40	"
32.20	2.00	"
34.00	0.0	"
Results at -25°		
23.50	0.0	Ice
21.80	1.40	"
16.60	5.60	"
10.60	10.60	"
0.0	18.80	"
0.0	24.30	$MgCl_2 \cdot 12H_2O$
16.30	17.40	$MgCl_2 \cdot 12H_2O + CaCl_2 \cdot 6H_2O$
16.90	16.90	$CaCl_2 \cdot 6H_2O$
25.00	8.40	"
31.60	2.10	"
33.60	0.0	"
Results at -30°		
25.00	0.0	Ice
23.60	1.60	"
18.00	6.00	"
11.40	11.40	"
0.0	24.40	"
0.0	22.50	$MgCl_2 \cdot 12H_2O$
15.80	15.80	$MgCl_2 \cdot 12H_2O + CaCl_2 \cdot 6H_2O$
18.20	15.20	$CaCl_2 \cdot 6H_2O$
24.60	8.20	"
31.20	2.00	"
33.40	0.0	"
Results at -35°		
26.60	0.0	Ice
25.00	1.60	"
19.20	6.40	"
12.20	12.20	"
8.00	16.40	$Ice + MgCl_2 \cdot 12H_2O$
14.30	14.30	$MgCl_2 \cdot 12H_2O$
21.00	11.60	$MgCl_2 \cdot 12H_2O + CaCl_2 \cdot 6H_2O$
24.30	8.10	$CaCl_2 \cdot 6H_2O$
30.60	2.00	"
32.40	0.0	"
Results at -40°		
28.20	0.0	Ice
26.40	1.70	"
20.30	6.70	"
12.70	12.70	"
11.00	14.40	$Ice + MgCl_2 \cdot 12H_2O$
13.40	13.40	$MgCl_2 \cdot 12H_2O$
23.40	8.80	$MgCl_2 \cdot 12H_2O + CaCl_2 \cdot 6H_2O$
24.00	8.10	$CaCl_2 \cdot 6H_2O$
30.00	1.95	"
32.00	0.0	"
Results at -45°		
29.50	0.0	Ice
27.60	1.60	"
21.10	6.00	"
17.10	10.40	$Ice + MgCl_2 \cdot 12H_2O$
22.60	7.50	$MgCl_2 \cdot 12H_2O$
25.00	6.50	$MgCl_2 \cdot 12H_2O + CaCl_2 \cdot 6H_2O$
29.40	1.90	$CaCl_2 \cdot 6H_2O$
31.80	0.0	"
Other Temperatures		
(-49.8°)	30.40	0.0	$Ice + CaCl_2 \cdot 6H_2O$
(-51.7°)	28.86	2.08	"
(-55.0°)	26.00	5.00	$Ice + CaCl_2 \cdot 6H_2O + MgCl_2 \cdot 12H_2O$
(-50.2°)	21.50	7.30	$Ice + MgCl_2 \cdot 12H_2O$
(-43.0°)	13.0	13.00	"
(-33.6°)	0.0	21.38	"

Cl

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - MAGNESIUM CHLORIDE - WATER AT 35° AND 75°

(Lightfoot and Prutton, 1946, 1947)

Results at 35°

Gms. $CaCl_2$ per 100 gms.	Gms. $MgCl_2$ per 100 gms.	Solid Phase
51.33	0.0	$CaCl_2 \cdot 4H_2O$ α
49.09	2.10	"
47.75	3.50	"
45.03	6.20	$CaCl_2 \cdot 4H_2O$ α + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
45.03	6.20	"
45.07	6.22	$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
39.25	9.49	"
35.64	11.88	"
35.15	12.19	"
30.06	15.67	"
26.98	17.95	"
26.78	18.04	"
26.70	18.13	$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 6H_2O$
26.66	18.24	"
23.15	20.28	$MgCl_2 \cdot 6H_2O$
18.89	23.17	"
9.81	29.07	"
3.63	33.56	"
0.0	36.28	"

Results at 75°

Gms. $CaCl_2$ per 100 gms.	Gms. $MgCl_2$ per 100 gms.	Solid Phase
58.58	0.0	$CaCl_2 \cdot 2H_2O$
55.76	2.53	"
52.59	5.27	$CaCl_2 \cdot 2H_2O$ + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
52.57	5.28	"
45.01	8.74	$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
34.97	14.70	"
29.15	18.63	"
19.28	25.55	"
13.83	29.65	"
12.52	30.59	"
10.15	32.39	"
9.97	32.59	"
8.31	33.90	$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 6H_2O$
8.31	33.91	"
8.04	34.07	$MgCl_2 \cdot 6H_2O$
3.84	36.62	"
0.0	39.12	"

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - POTASSIUM CHLORIDE - WATER AT 35°, 75° and 95°

(Lightfoot and Prutton, 1946, 1947)

Results at 35°

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase
0.0	28.04	KCl
3.12	24.66	"
7.28	20.77	"
13.37	15.59	"
19.75	10.77	"
26.45	6.89	"
31.56	4.89	"
38.37	3.74	"
43.56	4.25	"
46.48	4.90	"
47.65	5.10	"
50.47	6.48	KCl + $CaCl_2 \cdot 4H_2O$ α
50.43	6.48	"
50.70	3.26	$CaCl_2 \cdot 4H_2O$ α
51.02	1.28	"
51.06	0.82	"
51.33	0.0	"

Results at 95°

49.47	12.42	KCl + $2KCl \cdot CaCl_2 \cdot 2H_2O$
49.40	12.44	"
52.47	7.25	$2KCl \cdot CaCl_2 \cdot 2H_2O$
58.26	3.93	$2KCl \cdot CaCl_2 \cdot 2H_2O$ + $CaCl_2 \cdot 2H_2O$

Results at 75°

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase
0.0	33.16	KCl
11.73	21.62	"
18.27	16.00	"
28.47	9.62	"
37.65	6.77	"
42.84	6.97	"
47.64	8.43	"
Av. 50.20	10.33	KCl + $2KCl \cdot CaCl_2 \cdot 2H_2O$
50.34	10.36	$2KCl \cdot CaCl_2 \cdot 2H_2O$
50.92	9.36	"
53.85	6.21	"
54.03	6.08	"
54.52	5.45	"
54.79	5.55	"
56.33	4.51	"
56.28	4.33	"
56.57	4.20	"
56.79	4.00	"
57.00	3.92	"
57.66	3.59	$2KCl \cdot CaCl_2 \cdot 2H_2O$ + $CaCl_2 \cdot 2H_2O$
57.77	2.56	$CaCl_2 \cdot 2H_2O$
58.58	0.0	"

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - MAGNESIUM CHLORIDE - POTASSIUM CHLORIDE - WATER AT 35°

(Lightfoot and Prutton, 1948)

Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase
27.33	0.0	3.81	C + KCl
20.61	9.12	3.69	"
10.59	23.57	3.47	"
5.83	31.66	3.37	"
4.07	35.51	3.44	"
4.01	35.60	3.43	"
2.31	41.00	3.80	"
1.30	45.85	4.71	"
1.15	48.34	5.69	"
1.17	48.89	6.04	"
Av. 1.02	49.76	6.46	C + KCl + $CaCl_2 \cdot 4H_2O \alpha$
36.17	0.0	0.14	C + $MgCl_2 \cdot 6H_2O$
26.66	12.97	0.16	"
Av. 18.07	26.74	0.23	C + $MgCl_2$ + $6H_2O$ + T
14.23	32.01	0.32	C + T
13.83	32.60	0.33	"
7.28	42.75	0.71	"
6.98	43.27	0.76	"
6.15	44.44	0.97	"
Av. 5.91	45.30	0.99	C + $CaCl_2 \cdot 4H_2O \alpha$ + T
4.42	46.65	1.33	C + $CaCl_2 \cdot 4H_2O$
2.69	48.40	2.28	"
1.72	49.25	3.92	"
1.36	49.54	5.10	"
0.0	50.45	6.48	KCl + $CaCl_2 \cdot 4H_2O \alpha$
0.71	50.06	6.46	"
0.93	49.83	6.45	"
6.20	45.03	0.0	T + $CaCl_2 \cdot 4H_2O \alpha$
6.13	45.18	0.33	"
5.82	45.43	0.70	"
18.18	26.68	0.0	T + $MgCl_2 \cdot 6H_2O$
*4.34	48.18	1.41	C + T
*4.22	48.63	1.53	"
*3.97	49.24	1.64	"
Av. *3.39	50.49	2.10	C + T + $CaCl_2 \cdot 4H_2O \gamma$
*3.06	50.81	2.10	C + $CaCl_2 \cdot 4H_2O \gamma$
*2.05	51.78	3.91	"
*1.51	52.05	4.53	"
Av. *0.89	50.70	7.01	C + KCl + $CaCl_2 \cdot 4H_2O \gamma$

C = $KCl \cdot MgCl_2 \cdot 6H_2O$ T = $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$

Av. = Average * = Metastable

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE + MAGNESIUM CHLORIDE + POTASSIUM CHLORIDE + WATER AT 75°

(Lightfoot and Prutton, 1949)

Gms. per 100 gms. Saturated Solution			Solid Phase
$MgCl_2$	$CaCl_2$	KCl	
29.26	0.0	5.57	$KCl \cdot MgCl_2 \cdot 6H_2O$ + KCl
23.14	8.56	5.56	"
16.71	18.07	5.61	"
10.89	27.57	5.85	"
6.39	36.76	6.73	"
4.48	41.95	7.81	"
3.85	44.63	8.80	"
3.47	46.31	9.70	$KCl \cdot MgCl_2 \cdot 6H_2O$ + KCl + $2KCl \cdot CaCl_2 \cdot 2H_2O$
38.86	0.0	0.32	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $MgCl_2 \cdot 6H_2O$
36.20	4.26	.38	"
33.68	8.40	.39	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $MgCl_2 \cdot 6H_2O$ + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
26.95	16.96	.67	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
16.12	32.00	1.58	"
7.92	44.90	3.68	"
6.76	46.43	5.11	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$ + $2KCl \cdot CaCl_2 \cdot 2H_2O$
5.58	46.69	6.25	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $2KCl \cdot CaCl_2 \cdot 2H_2O$
0.0	57.66	3.59	$CaCl_2 \cdot 2H_2O$ + $2KCl \cdot CaCl_2 \cdot 2H_2O$
1.85	55.23	3.35	"
5.28	52.58	0.0	$CaCl_2 \cdot 2H_2O$ + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$
4.66	52.47	2.65	"
4.55	52.51	3.07	$CaCl_2 \cdot 2H_2O$ + $CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$ + $2KCl \cdot CaCl_2 \cdot 2H_2O$
4.51	52.29	3.19	$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$ + $2KCl \cdot CaCl_2 \cdot 2H_2O$
4.97	51.21	3.44	"
5.44	50.06	3.81	"
6.68	46.63	5.02	"
0.0	51.20	10.33	KCl + $2KCl \cdot CaCl_2 \cdot 2H_2O$
2.71	47.32	9.84	"
33.91	8.31	0.0	$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 6H_2O$

Data for the five-component system $CaCl_2$ + $MgCl_2$ + KCl + NaCl + H_2O at 35° are given by Meyer, Prutton, and Lightfoot, 1949.

THE SYSTEM $CaCl_2$ + $MgCl_2$ + NaCl + H_2O AT 25°

(Kurnakov and Nikolaev, 1938)

The authors present data for the system $CaCl_2$ + $MgCl_2$ + H_2O at 25° which agrees very closely with those of Lee and Egerton (Vol. I, p. 289) and add the following quaternary data:

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phases
38.83	9.56	0.30	$CaCl_2 \cdot 6H_2O$ + $2MgCl_2 \cdot CaCl_2 \cdot 12H_2O$ + NaCl
30.50	14.95	0.38	$MgCl_2 \cdot 6H_2O$ + $2MgCl_2 \cdot CaCl_2 \cdot 12H_2O$ + NaCl
23.40	19.15	0.32	$MgCl_2 \cdot 6H_2O$ + NaCl
10.44	27.70	0.32	"

THE SYSTEM $CaCl_2$ + $MgCl_2$ + NaCl + H_2O BELOW 30°

(Luzhnaja and Vereshtetina, 1946)

The authors studied the system at low temperatures by observing the temperature of initial crystallization upon cooling. They present data at constant ratios of $CaCl_2$: $MgCl_2$ with varying amounts of NaCl present. The following 3 phase equilibria were extracted from the tables.

Temp.°	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phases
-21.5	3.50	3.50	16.0	Ice + $NaCl \cdot 2H_2O$
-22.5	4.80	1.60	17.00	"
-24.3	2.05	6.15	13.90	"
-26.5	3.43	10.29	8.6	"
-26.5	7.20	7.20	9.0	"
-27.0	11.49	3.81	9.20	"
-39.0	5.84	17.54	1.72	"
-44.0	12.30	12.30	2.00	"
-52.0	20.96	6.98	1.66	"
- 0.5	3.95	3.95	18.5	$NaCl \cdot 2H_2O$ + NaCl
- 1.2	2.45	7.35	16.0	"
- 1.3	3.52	1.84	19.10	"
- 6.5	12.70	4.23	10.40	"
- 6.5	3.97	11.93	9.3	"
- 8.0	7.90	7.90	10.2	"
-19.5	13.85	13.85	2.40	"
-23.8	6.75	20.25	2.05	"
-25.0	14.65	14.65	1.60	"
-27.5	22.28	7.42	1.70	"
-38.3	5.69	17.09	0.32	Ice + $MgCl_2 \cdot 12H_2O$
-42.5	12.18	12.18	1.38	"
-17.5	8.28	24.86	0.56	$MgCl_2 \cdot 12H_2O$ + $NaCl \cdot 2H_2O$
-27.0	14.82	14.82	0.65	"
-30.0	13.15	13.15	1.42	"
-35	0.0	22.71	1.56	Ice + $MgCl_2 \cdot 12H_2O$ + $NaCl \cdot 2H_2O$
-26	0.0	23.35	1.81	$MgCl_2 \cdot 12H_2O$ + $NaCl \cdot 2H_2O$ + NaCl

The Quaternary Eutectic is about -58° with a ratio of about 17 : 83 $MgCl_2$: $CaCl_2$ in solution.

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - SODIUM CHLORIDE - WATER

(Yanatieva, 1946)

The author presents a diagram showing the phases present at all compositions and temperatures below 55° and gives data at constant temperature and at constant ratios of $CaCl_2$: NaCl. The ternary eutectic temperature is -52.0°, and the results at 0° and 25° agree fairly well with those of previous workers (Vol. I, p. 290).

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phase	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phase
Results at 25°			Results at 0°		
45.60	0.0	$CaCl_2 \cdot 6H_2O$	0.0	26.23	NaCl
0.0	26.80	NaCl	13.80	14.60	"
27.30	4.70	"	26.60	4.60	"
32.40	2.80	"	31.40	2.60	"
35.60	1.40	"	34.40	1.40	"
43.50	1.00	NaCl + $CaCl_2 \cdot 6H_2O$	37.60	1.10	NaCl + $CaCl_2 \cdot 6H_2O$

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phase
Results at -5°		
8.40	0.0	Ice
7.60	1.20	"
4.40	4.60	"
0.0	7.40	"
0.0	25.60	$NaCl \cdot 2H_2O$
4.80	21.20	$NaCl \cdot 2H_2O$ + NaCl
13.80	14.80	NaCl
26.40	4.60	"
30.80	2.42	"
33.80	1.40	"
34.20	1.10	NaCl + $CaCl_2 \cdot 6H_2O$
Results at -10°		
13.00	2.20	Ice
7.80	8.20	"
0.0	13.50	"
0.0	25.00	$NaCl \cdot 2H_2O$
13.40	14.20	"
24.00	5.80	$NaCl \cdot 2H_2O$ + NaCl
26.10	4.30	NaCl
30.70	2.40	"
33.80	1.20	NaCl + $CaCl_2 \cdot 6H_2O$
Results at -15°		
16.20	2.70	Ice
10.00	10.50	"
0.0	19.00	"
0.0	24.40	$NaCl \cdot 2H_2O$
13.00	13.80	"
25.80	4.80	$NaCl \cdot 2H_2O$ + NaCl
30.65	2.36	NaCl
33.60	1.40	"
33.70	1.30	NaCl + $CaCl_2 \cdot 6H_2O$
Results at -20°		
18.40	3.20	Ice
11.40	12.00	"
0.0	22.40	"
0.0	23.60	$NaCl \cdot 2H_2O$
12.90	13.60	"
25.40	4.40	"
29.00	3.00	$NaCl \cdot 2H_2O$ + NaCl
30.60	2.30	NaCl
33.30	1.30	"
33.40	1.35	NaCl + $CaCl_2 \cdot 6H_2O$

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phase
Results at -25°		
20.40	3.60	Ice
12.30	12.80	"
11.20	13.80	Ice + $NaCl \cdot 2H_2O$
12.80	13.40	$NaCl \cdot 2H_2O$
24.80	4.20	"
29.80	2.20	"
32.60	1.30	"
32.80	1.40	$NaCl \cdot 2H_2O$ + $CaCl_2 \cdot 6H_2O$
Results at -30°		
24.20	1.00	Ice
23.80	1.80	"
22.00	3.80	"
19.60	7.00	Ice + $NaCl \cdot 2H_2O$
24.70	1.20	$NaCl \cdot 2H_2O$
29.40	2.20	"
32.00	1.40	$NaCl \cdot 2H_2O$ + $CaCl \cdot 6H_2O$
Results at -35°		
25.80	1.00	Ice
25.60	1.80	"
23.80	4.00	"
23.50	4.50	Ice + $NaCl \cdot 2H_2O$
24.20	4.20	$NaCl \cdot 2H_2O$
28.80	2.20	"
31.60	1.45	$NaCl \cdot 2H_2O$ + $CaCl_2 \cdot 6H_2O$
Results at -40°		
27.20	1.00	Ice
26.80	2.00	"
26.20	3.10	Ice + $NaCl \cdot 2H_2O$
28.60	2.10	$NaCl \cdot 2H_2O$
31.00	1.50	$NaCl \cdot 2H_2O$ + $CaCl_2 \cdot 6H_2O$
Results at -45°		
28.60	1.20	Ice
27.80	2.20	"
27.40	2.50	Ice + $NaCl \cdot 2H_2O$
28.30	2.20	$NaCl \cdot 2H_2O$
30.30	1.60	$NaCl \cdot 2H_2O$ + $CaCl_2 \cdot 6H_2O$
30.40	1.20	$CaCl_2 \cdot 6H_2O$

Cl

THE SYSTEM $CaCl_2$ + NaCl + KCl + H_2O

(Yanatieva, 1947)

t°	Density	Gms. KCl per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Solid Phases
0	1.391	2.15	0.49	36.37	KCl + NaCl + $CaCl_2 \cdot 6H_2O$
25	1.250	9.59	14.06	7.62	KCl + NaCl
25	1.274	7.49	9.74	14.95	"
25	1.469	3.22	0.62	44.82	KCl + NaCl + $CaCl_2 \cdot 6H_2O$
50	1.266	18.27	20.74	8.48	KCl + NaCl
50	1.299	9.38	7.53	17.84	"
50	1.516	5.47	1.15	45.24	"
50	1.805	4.19	0.50	55.28	KCl + NaCl + $CaCl_2 \cdot 2H_2O$

Cl

Additional data for the quaternary system $CaCl_2$ + KCl + NaCl + H_2O at 25° are given by Zhdanovskii, 1948.

Equilibrium diagrams for the quaternary system $CaCl_2$ - $CaOCl_2$ - $Ca(OH)_2$ - H_2O at 10°, 20°, 30° and 40° are given by Ourisson, 1939.

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - INDIUM CHLORIDE - WATER AT ROOM TEMPERATURE

(Busslin, Ziemeck, and Schaepdryver, 1947)

Gms. per 100 ml. Sat. Sol.		Solid Phase	Gms. per 100 ml. Sat. Sol.		Solid Phase
$InCl_3$	$CaCl_2$		$InCl_3$	$CaCl_2$	
143.9	8.4	$InCl_3 \cdot 4H_2O$	93.4	30.6	$CaCl_2 \cdot InCl_3 \cdot 8H_2O$
135.3	10.8	$CaCl_2 \cdot 2InCl_3 \cdot 12H_2O$	64.3	45.8	"
127.6	13.6	$3CaCl_2 \cdot 4InCl_3 \cdot 30H_2O$	54.3	54.5	"
			12.4	60.1	"
			36.2	67.3	"

THE SYSTEM CALCIUM CHLORIDE - ZINC CHLORIDE - WATER AT 25° AND 60°

(Tschischikoff and Schachoff, 1936)

25° Gms. $ZnCl_2$ per 100 gms. Sat. Sol.	25° Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Solid Phase*	60° Gms. $ZnCl_2$ per 100 gms. Sat. Sol.	60° Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Solid Phase*
0.0	52.0	$CaCl_2$	0.0	57.8	$CaCl_2$
23.6	43.33	"	6.40	50.42	"
28.80	41.35	"	13.05	46.99	"
53.11	24.19	"	34.42	34.41	"
60.56	22.29	$CaCl_2 + ZnCl_2$	41.7	27.55	"
81.0	0.0	$ZnCl_2$	50.19	28.30	$CaCl_2 + ZnCl_2$
			47.6	27.09	"
			63.87	15.92	$ZnCl_2$
			76.09	6.58	"
			79.89	3.67	"
			80.49	2.01	"
			81.52	0.90	"
			83.0	0.0	"

*The degrees of hydration of the solid phases were not given

EQUILIBRIUM IN THE SYSTEM $CaCl_2 - CaS_2O_3 - H_2O$ AT 25°

(Silberman and Ivanov, 1946)

Gms. CaS_2O_3 per 100 gms. Sat. Sol.	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Solid Phase	Gms. CaS_2O_3 per 100 gms. Sat. Sol.	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Solid Phase
34.68	0.0	$CaS_2O_3 \cdot 6H_2O$	8.33	31.10	$CaS_2O_3 \cdot 6H_2O$
28.55	6.08	"	7.99	32.65	
24.10	10.24	"	7.49	33.34	$CaS_2O_3 \cdot 6H_2O + CaS_2O_3 \cdot H_2O$
20.80	12.75	"	3.45	38.46	$CaS_2O_3 \cdot H_2O$
16.24	17.16	"	1.43	42.30	"
14.20	19.75	"	1.32	43.16	"
13.88	20.76	"	1.03	45.01	$CaS_2O_3 \cdot H_2O + CaCl_2 \cdot 6H_2O$
10.15	26.88	"	0.0	45.65	$CaCl_2 \cdot 6H_2O$
9.21	29.68	"			

Cl

EQUILIBRIUM IN THE RECIPROCAL SYSTEM $CaCl_2 + Na_2S_2O_3 + H_2O$ AT 25°

(Silberman and Ivanov, 1946)

Gms. CaS_2O_3 per 100 gms. Sat. Sol.	Gms. $Na_2S_2O_3$ per 100 gms. Sat. Sol.	Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phases
0.0	32.98	0.0	9.86	$Na_2S_2O_3 \cdot 5H_2O + NaCl$
20.33	30.19	-	-	$Na_2S_2O_3 \cdot 5H_2O + CaS_2O_3 \cdot 6H_2O$
19.70	26.42	-	4.62	$Na_2S_2O_3 \cdot 5H_2O + CaS_2O_3 \cdot 6H_2O + NaCl$
20.20	23.90	-	5.42	$CaS_2O_3 \cdot 6H_2O + NaCl$
22.30	-	7.48	9.86	"
13.40	-	19.82	4.41	"
11.26	-	23.79	2.15	"
10.87	-	25.93	2.20	"
9.76	-	29.05	1.04	"
8.64	-	31.35	0.73	$CaS_2O_3 \cdot 6H_2O + CaS_2O_3 \cdot H_2O + NaCl$
7.99	-	32.65	-	$CaS_2O_3 \cdot 6H_2O + CaS_2O_3 \cdot H_2O$
6.85	-	31.07	0.81	$CaS_2O_3 \cdot H_2O + NaCl$
6.32	-	32.10	0.90	"
0.98	-	44.2	0.85	$CaS_2O_3 \cdot H_2O + CaCl_2 \cdot 6H_2O + NaCl$
0.0	-	43.52	1.02	$CaCl_2 \cdot 6H_2O + NaCl$
1.03	-	45.01	-	$CaS_2O_3 \cdot 6H_2O + CaCl_2 \cdot 6H_2O$

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - DIOXANE - WATER AT 25°

(Bogardus and Lynch, 1948)

The solid phases were identified by wet residue analyses.

Gms. $CaCl_2$ per 100 gms. Sat. Sol.	Gms. Dioxane per 100 gms. Sat. Sol.	Solid Phase
44.8	1.3	$CaCl_2 \cdot 6H_2O$
44.5	2.5	$CaCl_2 \cdot 6H_2O + CaCl_2 \cdot (C_2H_4)_2O_2 \cdot 2H_2O$
43.9	3.7	$CaCl_2 \cdot (C_2H_4)_2O_2 \cdot 2H_2O$
41.6	7.3	"
39.8	10.0	"
39.1	11.1	"
36.5	15.0	"
33.8	19.7	"
* 28.6	27.9	Upper Layer
0.00	98.54	Lower Layer
19.3	32.8	Upper Layer
0.00	95.98	Lower Layer
12.8	40.2	Upper Layer
0.05	92.71	Lower Layer
6.41	54.0	Upper Layer
0.99	80.5	Lower Layer

*Two liquid phases in equilibrium with $CaCl_2 \cdot (C_2H_4)_2O_2 \cdot 2H_2O$

EQUILIBRIUM IN THE SYSTEM CALCIUM CHLORIDE - METHYL ETHYL KETONE - WATER AT ROOM TEMPERATURE (23.5° - 26°)

(Meissner and Stokes, 1944)

Water was determined by difference in the water layer, and Methyl Ethyl Ketone by difference in the Ketone Layer.

Water Layer Wt. %			Ketone Layer Wt. %	
$CH_3COC_2H_5$	$CaCl_2$	H_2O	H_2O	$CH_3COC_2H_5$
-	45.0	55.0	-	-
1.96	43.50	54.5	0.705	99.3
2.26	33.65	64.1	1.87	98.1
3.42	26.10	70.5	4.11	95.9
5.11	20.35	74.5	5.22	94.8
10.6	10.40	79.0	7.61	92.4
16.8	4.12	79.1	12.00	88.0
22.4	0.0	77.6	12.60	87.4

Cl

100 gms. Monoethanol Amine dissolve 14.0 gms. $CaCl_2$ at 25°. (Isbin and
100 gms. Ethylene Glycol dissolve 20.6 gms. $CaCl_2$ at 25°. Kobe, 1941).

—100 gms. of a solution of $CaCl_2$ in Furfural contains 0.01 gms. $CaCl_2$ at 25°

—100 gms. of a solution of $CaCl_2 \cdot 2H_2O$ in Furfural contains 0.08 gms. $CaCl_2$ at 25°. (Trimble, 1941).

100 gms. of a mixture of equal volumes of Water and Ethyl Ether saturated with HCl at 0° will dissolve 0.49 gms. $CaCl_2$. (Fischer and Seidel, 1941).

SOLUBILITY OF CALCIUM CHLORIDE - ACETIC ACID COMPLEXES

(Gerbault, 1946)

The compounds were prepared by the action of Acetyl Chloride on Calcium Hydroxide. Solubilities are in terms of Moles per Liter. [Ac = CH_3CO-]

Compound	Solvent			
	Water	Ethyl Alcohol	Acetic Acid	Ethyl Ether
$CaCl_2 \cdot AcOH$	1.1	-	0.053	0.0035
$CaCl \cdot AcO$	0.034	0.066	0.082	-
$CaCl \cdot AcO \cdot CaO$	0.067	.128	0.167	0.097

The solubility of $CaCl_2$ in Glycine Solutions is reported by Joseph, 1935.

Distribution data for the system $CaCl_2 + HCl + (C_2H_5)O + H_2O$, which exists as three liquid layers, are given by Szaffka, 1942.

Melting point data are given for the following:

$CaCl_2$ + KF (Ternary System) Krauze and Bergman, 1942.

$CaCl_2 + ZrO_2$ (In Atmospheres of Cl_2 and HCl) Belozerskii and Kucherenko, 1940.

$CaCl_2 + Li_2F_2 \rightleftharpoons CaF_2 + Li_2Cl_2$ Buchalova and Bergman, 1949.

The density, conductivity, viscosity and surface tension are given for the system $CaCl_2$ + NaCl by Barzakovskii, (1940, 1940a).

The specific volumes and heat capacities of solutions of $CaCl_2$ + NH_4NO_3 are given by Rutskov, 1948.

CALCIUM CHROMATE $CaCrO_4$ CrO

Melting points in the systems $CaCrO_4$ + $Ca(NO_3)_2$, $CaCrO_4$ + K_2CrO_4 and $CaCrO_4$ + $2KNO_3 \rightleftharpoons K_2CrO_4$ + $Ca(NO_3)_2$ are given by Kitrov, 1949.

Melting points in the system $CaCrO_4$ + Na_2CrO_4 were determined by Vilinyanskii and Pudovkina, 1948.

The melting point diagram for the quaternary system $CaCrO_4$ + $Na_2CO_3 \rightleftharpoons$ $CaCO_3$ + Na_2CrO_4 is given by Vilinyanskii and Pudovkina, 1948a.

CALCIUM IODIDE CaI_2 I

EQUILIBRIUM IN THE SYSTEM CALCIUM IODIDE - INDIUM IODIDE - WATER AT ROOM TEMPERATURE

(Ensslin, Ziemeck, and Schaepdryver, 1947)

Gms. per 100 ml. Sat. Sol.		Solid Phase	Gms. per 100 ml. Sat. Sol.		Solid Phase
InI_3	CaI_2		InI_3	CaI_2	
124.3	69.7	$CaI_2 \cdot 2InI_3 \cdot 8H_2O$	3.8	117.9	$CaI_2 \cdot InI_3 \cdot 6H_2O$
22.5	107.1	"	3.2	124.7	CaI_2 aq.
10.9	112.2	$2CaI_2 \cdot 3InI_3 \cdot 13H_2O$	1.6	131.5	"

CALCIUM IODATE $Ca(IO_3)_2$ IO

SOLUBILITY OF CALCIUM IODATE IN UREA AND DIOXANE SOLUTIONS

(Pedersen, 1941)

Solid Phase = $Ca(IO_3)_2 \cdot 6H_2O$

With Urea Added (17.9°)

Mols. Urea per 1000 ml. Solvent	Gms. Urea per 1000 ml. Solvent	Mols. $Ca(IO_3)_2$ per 1000 ml. Sat. Sol.	Gms. $Ca(IO_3)_2$ per 1000 ml. Sat. Sol.
0.0	0.0	0.005686	2.217
0.100	.6006	.005821	2.269
.200	1.201	.005957	2.323
.400	2.4024	.006233	2.430
.600	3.6036	.006512	2.539
.800	4.8048	.006805	2.653
1.000	60.06	.007103	2.770
2.000	120.1	.008689	3.388
4.000	240.2	.01258	4.905
6.000	360.4	.01767	6.890
8.000	480.5	.02496	9.732

With Dioxane Added (18.00°)

Mols. Dioxane per 1000 ml. Solvent	Gms. Dioxane per 1000 ml. Solvent	Mols. $Ca(IO_3)_2$ per 1000 ml. Sat. Sol.	Gms. $Ca(IO_3)_2$ per 1000 ml. Sat. Sol.
0.0		0.005702	2.223
.125	11.01	.005423	2.114
.250	22.02	.005159	2.004
.375	33.04	.004904	1.912
.500	44.05	.004652	1.814
.750	66.08	.004194	1.635
1.000	88.10	.003771	1.470

IO

SOLUBILITY OF CALCIUM IODATE IN MAGNESIUM IODATE SOLUTIONS AT 17.9°

(Pedersen, 1941)

Solid Phase = $Ca(IO_3)_2 \cdot 6H_2O$

Mols. $Mg(IO_3)_2$ per 1000 ml. Solvent	Gms. $Mg(IO_3)_2$ per 1000 ml. Solvent	Mols. $Ca(IO_3)_2$ per 1000 ml. Sat. Sol.	Gms. $Ca(IO_3)_2$ per 1000 ml. Sat. Sol.
0.0	0.0	0.005686	2.217
.001009	.3775	.005087	1.984
.002011	.7524	.004528	1.766
.003012	1.127	.004029	1.571
.005000	1.871	.003174	1.238
.01000	3.742	.001771	0.6905

SOLUBILITY OF CALCIUM IODATE IN POTASSIUM CHLORIDE SOLUTIONS AT 25°

(Keefer, Rieber, and Bisson, 1940)

Mols. KCl per 1000 gms. H_2O	Gms. KCl per 1000 gms. H_2O	Mols. $Ca(IO_3)_2$ per 1000 gms. H_2O	Gms. $Ca(IO_3)_2$ per 1000 gms. H_2O
0.0	0.0	0.00786	3.065
.02514	1.874	.00885	3.450
.05036	3.754	.00970	3.782
.1008	7.515	.01053	4.106

SOLUBILITY OF CALCIUM IODATE IN GLYCINE AND ALANINE SOLUTIONS AT 25°

(Keefer, Rieber, and Bisson, 1940)

Glycine		$Ca(IO_3)_2$		Alanine		$Ca(IO_3)_2$	
Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O
0.0251	1.884	0.00806	3.143	0.0251	2.236	0.00800	3.119
.0503	3.776	.00823	3.209	.0503	4.481	.00814	3.174
.0755	5.668	.00849	3.310	.0755	6.726	.00829	3.232
.1008	7.567	.00865	3.373	.1008	8.980	.00845	3.295
.2009	15.08	.00951	3.708				
.4055	30.44	.01111	4.332				
.6140	46.09	.01297	5.057				
.8261	62.02	.01495	5.829				

SOLUBILITY OF CALCIUM IODATE IN SOLUTIONS CONTAINING GLYCINE AND POTASSIUM CHLORIDE AT 25°

(Keefer, Rieber, and Bisson, 1940)

IO

KCl		Glycine		$Ca(IO_3)_2$	
Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O	Mols. per 1000 gms. H_2O	Gms. per 1000 gms. H_2O
0.02516	0.1876	0.02511	1.885	0.00899	3.505
.02519	.1878	.05030	3.776	.00920	3.587
.02522	.1880	.07552	5.669	.00939	3.661
.02525	.1882	.1008	7.567	.00959	3.739
.05036	.3754	.02513	18.87	.00970	3.782
.05041	.3758	.05032	37.78	.00990	3.860
.05047	.3763	.07558	56.74	.01006	3.922
.0.5053	.3767	.1009	75.75	.01027	4.004
.1009	.7522	.02517	18.90	.01073	4.184
.1010	.7530	.05041	37.84	.01093	4.262
.1011	.7537	.07570	56.83	.01115	4.348

CALCIUM PERMANGANATE $Ca(MnO_4)_2$

MnO

Bellinger, Friedman, et al. (1946) determined the freezing points of aqueous solutions of Calcium Permanganate. Their material analyzed 51.9% total MnO_4^-, of which about 1% was $NaMnO_4$. The purity was 76.5% when the total MnO_4^- was calculated as $Ca(MnO_4)_2 \cdot 2H_2O$.

$\%MnO_4^-$	Freezing Point	$\%MnO_4^-$	Freezing Point
5	-1°	42	-37°
15	-4.5°	45	-53°
25	-10°	52	-49°
35	-22°		

CALCIUM NITRATE $Ca(NO_3)_2$

NO

EQUILIBRIUM IN THE SYSTEM $Ca(NO_3)_2 - HNO_3 - H_2O$ AT 50°

(Belopolsky and Urusov, 1937)

$Ca(NO_3)_2$, $Ca(NO_3)_2 \cdot 2H_2O$, and $Ca(NO_3)_2 \cdot 3H_2O$ are all stable phases in the system and the area of saturation with respect to $Ca(NO_3)_2 \cdot 3H_2O$ is isolated from the other two saturation areas. This occurs because $Ca(NO_3)_2 \cdot 3H_2O$ melts congruently at 51.1°, and in the system $Ca(NO_3)_2$-H_2O, the invariant points saturated with $Ca(NO_3)_2 \cdot 3H_2O$ + $Ca(NO_3)_2 \cdot 2H_2O$ and $Ca(NO_3)_2 \cdot 3H_2O$ + $Ca(NO_3)_2 \cdot 4H_2O$ are at 49° and 40° respectively. (See Bassett and Taylor, Vol. I, p. 303).

Gms. $Ca(NO_3)_2$ per 100 gms. Sat. Sol.	Gms. HNO_3 per 100 gms. Sat. Sol.	Solid Phase
*77.9	0.0	$Ca(NO_3)_2 \cdot 2H_2O$
75.93	1.46	$Ca(NO_3)_2 \cdot 2H_2O + Ca(NO_3)_2$
73.90	4.19	$Ca(NO_3)_2$
72.25	5.91	"
67.65	9.83	"
59.03	17.26	"
49.61	25.91	"
26.37	48.89	"
12.13	64.79	"
3.49	75.77	"
1.90	78.76	"
0.0	97.57	"
*76.82	0.0	$Ca(NO_3)_2 \cdot 3H_2O$
76.45	.74	"
74.91	.92	"
74.3	.5	"
74.07	0.0	"

NO

*Bassett and Taylor

EQUILIBRIUM IN THE SYSTEM CALCIUM NITRATE - UREA - WATER AT 25°

(Sakai, 1940a)

Gms. $Ca(NO_3)_2$ per 100 gms. Sat. Sol.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase
0.0	54.5	$CO(NH_2)_2$
4.64	54.62	"
6.32	55.46	"
10.80	56.21	"
14.88	56.35	"
*18.20	59.5	$CO(NH_2)_2 + Ca(NO_3)_2 \cdot 4CO(NH_2)_2$
19.17	59.90	$Ca(NO_3)_2 \cdot 4CO(NH_2)_2$
19.87	58.44	"
21.98	51.92	"
28.24	39.41	"
30.07	31.21	"
46.15	21.87	"
52.30	18.49	"
54.86	15.93	"
56.14	15.98	"
*60.5	11.2	$Ca(NO_3)_2 \cdot 4CO(NH_2)_2 + Ca(NO_3)_2 \cdot 4H_2O$
59.33	10.28	$Ca(NO_3)_2 \cdot 4H_2O$
60.04	6.4	"
59.64	5.39	"
58.45	2.26	"
59.70	0.0	"

*Average of several determinations in fair agreement with each other.

SOLUBILITY OF CALCIUM NITRATE IN CALCIUM PHOSPHATE SOLUTIONS EQUILIBRIUM IN THE SYSTEM $CaO + N_2O_5 + P_2O_5 + H_2O$ AT 25° and 50°

(Belopolsky, Serebrennikova, and Shpunt, 1937, 1937a)

Grams per 100 gms. of Saturated Solution			Density	Solid Phase
P_2O_5	CaO	N_2O_5		
			Results at 25°	
24.20	5.81	0.0	-	$Ca(H_2PO_4)_2 \cdot H_2O + CaHPO_4$
23.00	6.10	1.46	1.280	"
21.20	6.53	3.17	1.298	"
19.53	7.22	4.78	1.298	"
17.07	8.06	7.45	1.291	"
14.60	8.72	10.18	1.320	"
12.51	9.58	12.77	1.328	"
10.45	10.52	16.06	1.341	"
8.19	11.86	20.60	1.366	"
7.69	12.08	19.00	1.370	"
5.65	13.37	22.80	1.392	"
4.96	13.95	24.27	1.408	"
3.55	15.37	27.46	1.446	"
2.02	17.57	31.71	1.486	"
1.25	18.70	34.87	1.539	"
1.18	19.73	37.26	1.551	$Ca(H_2PO_4)_2 \cdot H_2O + CaHPO_4 + Ca(NO_3)_2 \cdot 4H_2O$
0.97	19.68	37.60	1.551	$CaHPO_4 + Ca(NO_3)_2 \cdot 4H_2O$
0.36	19.66	37.58	1.558	"
-	19.79	38.20	1.563	$Ca_3(PO_4)_2 + CaHPO_4 + Ca(NO_3)_2 \cdot 4H_2O$
2.05	19.25	36.21	1.552	$Ca(H_2PO_4)_2 \cdot H_2O + Ca(NO_3)_2 \cdot 4H_2O$
3.79	18.75	35.47	1.576	"
4.45	18.53	34.60	1.542	"
5.54	18.23	34.69	1.568	"
8.10	17.42	32.60	1.563	"
9.92	16.85	32.30	1.579	"
10.84	16.14	31.90	1.571	"
12.01	16.29	30.92	-	"
12.62	15.80	30.94	1.577	"
15.69	14.70	29.76	-	"
17.79	14.27	29.86	-	"
18.21	14.24	30.36	1.572	$Ca(H_2PO_4)_2 \cdot H_2O + Ca(NO_3)_2 \cdot 4H_2O + Ca(NO_3)_2 \cdot 3H_2O$
21.49	12.82	30.76	-	$Ca(H_2PO_4)_2 \cdot H_2O + Ca(NO_3)_2 \cdot 3H_2O$
23.94	11.79	30.43	-	"
26.74	10.82	30.70	-	"
29.90	9.76	29.83	-	"
34.63	7.78	26.89	1.637	"
35.62	7.27	25.32	1.656	"
37.05	6.81	25.62	1.670	"
39.25	5.70	23.08	1.679	"
41.70	4.99	21.52	1.684	"
44.56	4.23	19.34	1.592	"
0.0	11.03	51.89	1.536	$Ca(NO_3)_2 \cdot 4H_2O + Ca(NO_3)_2 \cdot 3H_2O$
2.84	12.29	49.94	1.559	"
3.98	12.10	49.03	-	"
4.54	12.78	47.70	1.566	"
6.04	12.91	47.86	-	"
7.68	13.57	46.05	1.588	"
7.74	13.49	44.44	1.586	"
9.31	14.34	41.61	1.605	"
11.30	14.76	40.52	1.596	"
14.03	14.60	37.10	1.605	"
14.96	14.11	34.53	1.605	"

Grams per 100 gms. of Saturated Solution			Density	Solid Phase
P_2O_5	CaO	N_2O_5		
			Results at 25° (Con.)	
0.0	9.54	56.28	1.525	$Ca(NO_3)_2 \cdot 3H_2O$ + $Ca(NO_3)_2 \cdot 2H_2O$
3.77	9.65	53.03	1.555	"
7.13	8.43	51.93	1.555	"
10.12	8.07	50.11	1.571	"
13.56	7.41	47.35	1.590	"
16.52	6.83	44.54	1.599	"
21.23	6.20	41.10	1.612	"
23.28	5.47	38.44	1.610	"
23.68	5.06	38.69	1.618	"
25.37	4.89	37.34	1.630	"
29.95	3.50	34.15	1.647	"
33.50	2.53	31.27	1.659	"
37.67	1.80	29.08	1.653	"
40.95	1.28	26.85	1.665	"
43.15	1.19	25.88	1.670	"
0.0	2.79	62.84	1.459	$Ca(NO_3)_2 \cdot 2H_2O$ + $Ca(NO_3)_2$
4.21	2.03	61.12	1.468	"
6.93	1.56	59.56	1.487	"
9.97	1.24	56.75	1.481	"
14.03	0.99	54.0	1.499	"
17.92	0.58	52.40	1.509	"
23.34	0.35	48.89	1.541	"
28.51	0.23	44.77	1.564	"
30.65	0.0	42.65	1.560	"
			Results at 50°	
28.85	5.88	0.0	1.314	$Ca(H_2PO_4)_2 \cdot H_2O$ + $CaHPO_4$
24.71	6.82	4.24	-	"
20.62	8.15	8.32	1.326	"
15.48	10.81	16.65	1.374	"
12.23	13.00	22.53	1.427	"
11.19	14.77	26.81	1.482	"
10.11	15.94	29.56	-	"
9.71	17.60	33.58	-	"
7.80	19.93	38.62	-	"
6.53	21.54	41.65	-	"
4.80	23.41	45.81	-	$Ca(H_2PO_4)_2 \cdot H_2O$ + $CaHPO_4$ + $Ca(NO_3)_2 \cdot 2H_2O$
11.12	20.79	43.28	-	$Ca(H_2PO_4)_2 \cdot H_2O$ + $Ca(NO_3)_2 \cdot 2H_2O$ + $Ca(NO_3)_2$
11.55	20.24	42.56	-	$Ca(H_2PO_4)_2 \cdot H_2O$ + $Ca(NO_3)_2$
18.26	15.43	37.59	-	"
19.76	14.79	36.60	1.622	"
27.03	10.85	31.10	1.641	"
30.87	9.33	29.86	1.655	"
36.27	7.30	26.63	1.653	"
45.57	5.63	19.40	1.684	"
48.11	5.40	18.39	-	"
0.0	25.95	51.23	-	$Ca(NO_3)_2 \cdot 2H_2O$ + $Ca(NO_3)_2$
3.16	24.36	48.75	-	"
4.85	23.11	48.21	-	"
5.42	23.64	48.00	-	"
7.34	22.69	46.43	-	"
9.38	21.77	45.01	-	"
11.12	20.79	43.28	-	$Ca(H_2PO_4)_2 \cdot H_2O$ + $Ca(NO_3)_2 \cdot 2H_2O$ + $Ca(NO_3)_2$

EQUILIBRIUM IN THE SYSTEM CALCIUM NITRATE - AMMONIUM NITRATE - WATER AT 10°, 20°, 30°

(Lamberger and Paris, 1948)

The authors list the invariant points in the system at 10°, 20° and 30° and present the entire diagram at 20°. Each of the double salts exists metastably over a range of solution compositions, and at 10° the range of metastability was very large compared to the stable range. Results are in terms of grams per 100 gms. of saturated solution.

Solid Phase	10°			20°			30°		
	NH_4NO_3	$Ca(NO_3)_2$	Density	NH_4NO_3	$Ca(NO_3)_2$	Density	NH_4NO_3	$Ca(NO_3)_2$	Density
NH_4NO_3	59.6	0.0	1.286	64.7	0.0	1.309	70.0	0.0	1.328
NH_4NO_3 + 1:1:2	33.7	42.0	1.635	37.0	41.1	1.638	41.5	39.7	1.638
1:1:2 + 1:5:10	27.4	45.5	1.641	29.5	45.6	1.650	33.9	44.8	1.657
1:5:10 + $Ca(NO_3)_2 \cdot 4H_2O$	26.6	45.6	1.639	18.2	51.0	1.638	9.5	56.7	1.646
$Ca(NO_3)_2 \cdot 4H_2O$	0.0	51.5	1.523	0.0	54.7	1.556	0.0	58.9	1.600

1:1:2 = $NH_4NO_3 \cdot Ca(NO_3)_2 \cdot 2H_2O$ 1:5:10 = $NH_4NO_3 \cdot 5Ca(NO_3)_2 \cdot 10H_2O$

NO.

EQUILIBRIUM IN THE SYSTEM CALCIUM NITRATE - STRONTIUM NITRATE - WATER AT 25° AND 60°

(Kobe and Stewart, 1942)

Results at 25°

Gms. $Sr(NO_3)_2$ per 100 gms. Sat. Sol.	Gms. $Ca(NO_3)_2$ per 100 gms. Sat. Sol.	Solid Phase
44.50	0.0	$Sr(NO_3)_2 \cdot 4H_2O$
32.30	12.23	$Sr(NO_3)_2 \cdot 4H_2O + Sr(NO_3)_2$
27.70	17.60	$Sr(NO_3)_2$
19.90	25.90	"
9.25	39.15	"
6.54	44.00	"
4.85	46.80	"
4.71	47.05	"
4.58	48.10	"
3.15	51.00	"
1.55	56.10	$Sr(NO_3)_2 + Ca(NO_3)_2 \cdot 4H_2O$
0.0	57.20	$Ca(NO_3)_2 \cdot 4H_2O$

Results at 60°

48.25	0.0	$Sr(NO_3)_2$
15.42	33.04	"
4.20	51.00	"
0.14	70.20	"
.084	76.00	"
.07	76.96	$Ca(NO_3)_2 + Sr(NO_3)_2$
0.0	77.15	$Ca(NO_3)_2$

100 cc of a saturated solution of Calcium Nitrate in Isoamyl Alcohol contains 3.73 gms. $Ca(NO_3)_2 \cdot 4H_2O$ at room temperature.

100 cc of a saturated solution of Calcium Nitrate in Methyl-n Hexyl Ketone contains less than 0.1 gm. $Ca(NO_3)_2 \cdot 4H_2O$ at room temperature.

(over)

At room temperature the distribution ratio of Calcium Nitrate between Methyl n-Hexyl Ketone and Water is 0.012 when there is 31.9 wt. % $Ca(NO_3)_2$ in the water phase. (Rothschild, Templeton and Hall, 1948).

100 cc of a saturated solution of Calcium Nitrate in Furfural contains 0.44 gms. $Ca(NO_3)_2 \cdot 4H_2O$ at 25°. (Trimble, 1941).

NC

Melting points have been determined in the following systems:

$Ca(NO_3)_2 + KNO_3$	Janecke, 1942, Kitrov, 1949
$Ca(NO_3)_2 + NaNO_3$	Janecke, 1942
$Ca(NO_3)_2 + Mg(NO_3)_2$	Janecke, 1942
$Ca(NO_3)_2 + Mg(NO_3)_2 + KNO_3$	Janecke, 1942
$Ca(NO_3)_2 + Mg(NO_3)_2 + NaNO_3$	Janecke, 1942
$Ca(NO_3)_2 + KNO_3 + NaNO_3$	Janecke, 1942
$Ca(NO_3)_2 + KNO_3 + NaNO_3 + Mg(NO_3)_2$	Janecke, 1942
$Ca(NO_3)_2 + KNO_3 + NaNO_3$	Bergman, 1943
$Ca(NO_3)_2$ + Guanidine Nitrate	Clark and Esterbrook, 1949

The following systems have been studied:

$Ca(NO_3)_2 + H_2O$ (Conductivities and coefficients of viscosity) (Bak, 1939)

$Ca(NO_3)_2 + KNO_3$ (Conductivities) (Natzvlishvili and Bergman, 1943)

$Ca(NO_3)_2 + NaNO_3 + KNO_3$ (Heat capacities) (Andsov and Voskressenskaya, 1945)

C CALCIUM OXIDE CaO

Data are given for the following systems:

$CaO + SiO_2$	Kolobova (1941)
$CaO + MnO$	Jay and Andrews (1944), Fettersson (1946)
$CaO + V_2O_5$	Morozov (1938)
$CaO + CaC_2$	Aall (1939)
$CaO + Fe_2O_3$ (Slag)	Hay and White (1940)
$CaO + SiC_2 + P_2O_5$	Barrett and McCaughey (1942, 1944), Tromel (1943) Schleede (1942), Tromel, Harkort and Hotop (1948)
$CaO + SiO_2 + Na_2C$	Lukesh (1948)
$CaO + SiO_2 + Fe_2O_3$	Burdick (1940)
$CaO + SiO_2 + Al_2O_3$	Clark (1946)

See also: Eitel (1941): $CaO + 5CaO \cdot Al_2O_3 + CaF_2$, Eubank and Bogue (1948): $Na_2O + 4CaO \cdot Al_2O_3 \cdot FeO + Na_2O \cdot 3Al_2O_3$, Parker and Nurse (1943): part of $CaO + MgO + SiO_2$, Vasenin (1939): $CaO \cdot Cr_2C_3 + CaO \cdot Al_2O_3$, Vasenin (1939) and Taylor (1941): $2CaO \cdot SiO_2 + K_2O \cdot CaO \cdot SiO_2$, Machin and Yee (1948): Viscosities of $CaO + Al_2O_3 + SiO_2$, Preston (1941): $Na_2O \cdot 2SiO_2 + CaO \cdot SiO_2$, Kroger and Illner (1940): $Na_2O + CaO + SiO_2 + CO_2$, Swayze (1946): $CaO + 5CaO \cdot 3Al_2O_3 + 2CaO \cdot Fe_2O_3$ etc.

The solubility of slags in the system $CaO \cdot P_2O_5 \cdot SiO_2$ in Citric Acid Solutions increases with increasing silicon content. (Willems, 1943).

CALCIUM HYDROXIDE $Ca(OH)_2$

Oka, 1940 found the solubility to be 2.1×10^{-2} moles per liter by potentiometric titration.

SOLUBILITY OF CALCIUM HYDROXIDE IN WATER AND CALCIUM SULFATE SOLUTIONS AT 25°

(Jones, 1939)

These results are similar to those of Cameron and Bell (Vol. I, p. 312) but the solubility of $Ca(OH)_2$ in $CaSO_4$ solutions is a little less than previously reported. The value for the solubility of $Ca(OH)_2$ in water is the mean of 9 determinations with recrystallized $Ca(OH)_2$ shaken 1 to 28 days, and the estimated error is ±0.01.

Gms. $CaSO_4$ per 1000 gms. Sat. Sol.	Gms. CaO per 1000 gms. Sat. Sol.	Solid Phase
2.09	0.0	$CaSO_4 \cdot 2H_2O$
1.70	1.04	$CaSO_4 \cdot 2H_2O + Ca(OH)_2$
1.69	1.06	$Ca(OH)_2$
0.0	1.08	"

SOLUBILITY OF CALCIUM OXIDE IN SODIUM AND POTASSIUM HYDROXIDE SOLUTIONS

(Pratini, 1949)

In KOH Solutions				In NaOH Solutions			
KOH		CaO		NaOH		CaO	
Moles per Liter	Gms. per Liter	Moles per Liter	Gms. per Liter	Moles per Liter	Gms. per Liter	Moles per Liter	Gms. per Liter
At 20°				At 20°			
0.0206	1.156	0.0152	0.852	0.0	0.0	0.0210	1.177
.0412	2.312	.0109	.611	0.0252	1.008	.0139	0.779
.0746	4.186	.0068	.381	.0525	2.100	.0092	.516
.1048	5.836	.0049	.275	.1035	4.140	.0050	.281
.1537	8.624	.0033	.185	.1058	4.233	.0051	.286
.2120	11.900	.0027	.151	.1535	6.141	.0035	.196
				.2090	8.361	.0026	.146
At 40°				At 40°			
0.0200	1.122	0.0123	0.690				
.0737	4.135	.0050	.280	0.0	0.0	0.0180	1.010
.1012	5.680	.0036	.202	.050	2.000	.0071	.399
.1977	11.090	.0019	.010	.1495	5.980	.0025	.011

Results for the solubility of $Ca(OH)_2$ in NaCl and KCl solutions at 20° are given by Dschorbenadse, Mosebach, and Naken, 1942.

THE SOLUBILITY OF $Ca(OH)_2$ AND $CaSO_4$ IN DILUTE ALKALI SOLUTIONS AT 25°, 30°

(Hansen and Pressler, 1947)

The solubility of $Ca(OH)_2 + CaSO_4$ in solutions of Na_2O or K_2O, or a mixture of the two was determined at 25° and 30°. The solubilities were the same whether Na_2O or K_2O or $Na_2O + K_2O$ was used, and were not appreciably affected by the temperature change. The solid phase was at all times $Ca(OH)_2 + CaSO_4 \cdot 2H_2O$. The data below were selected from many values given by the authors.

Gm. Moles $Na_2O + K_2O$ per Liter of Aqueous Solvent	Composition of solution in Contact with $Ca(OH)_2 + CaSO_4 \cdot 2H_2O$ Gm. moles per liter		
	CaO	SO_3	OH
0.0	0.0319	0.0125	0.0387
.0201	.0236	.0196	.0477
.0402	.0198	.0303	.0602
.0601	.0187	.0430	.0710
.1002	.0162	.0710	.0806
.5012	.0093	.2083	.1386
1.0023	.0034	.3662	.2752

OH

SOLUBILITY OF $Ca(OH)_2$ IN GLUCOSE SOLUTIONS (Temperature not given)

(Balezin, 1946)

The solubility of $Ca(OH)_2$ increases without changing the pH of the solution.

Gms. Glucose per 100 ml. Sat. Sol.	Gms. CaO per 100 ml. Sat. Sol.	Gms. Glucose per 100 ml. Sat. Sol.	Gms. CaO per 100 ml. Sat. Sol.
0.0	0.112	2.0	0.264
.25	.118	5.0	.710
.5	.142	15.0	2.157
1.0	.185	20.0	2.400

100 gms. of a saturated solution of $Ca(OH)_2$ in Furfural contains 0.13 gms. $Ca(OH)_2$ at 25° (Trimble, 1941).

Kalousek (1944) studied the system $Na_2O - CaO - SiO_2 - H_2O$ in part at 25° and found the stable phases to be $Ca(OH)_2$ and a quaternary soda - lime - silica gel.

Data for the system $CaO + P_2O_5 + HCl + H_2O$ at 25° and 40° are given by Taperova and Shulgina, 1946.

CALCIUM PHOSPHATE $CaHPO_4$, $Ca(H_2PO_4)_2$ PO

SOLUBILITY OF CALCIUM PHOSPHATES IN PHOSPHONIC ACID SOLUTIONS AT VARIOUS TEMPERATURES

(Belopolski, Serebrennikova, and Bilevic, 1940)

These results are in good agreement with those of Bassett (Vol. I, p. 321) and Elmore and Farr (Below). The vapor pressure of each solution was also determined.

Gms. P_2O_5 per 100 gms. Sat. Sol.	Gms. CaO per 100 gms. Sat. Sol.	Density	Solid Phase
	Results at 25°		
0.86	2.88	1.109	$CaHPO_4$
15.29	4.14	1.174	"
21.11	5.34	1.270	"
24.47	5.80	1.298	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
30.40	4.51	1.337	$Ca(H_2PO_4)_2 \cdot H_2O$
35.61	3.39	1.375	"
40.14	2.31	1.419	"
46.39	1.33	1.466	"
48.60	0.92	1.486	"
53.74	.50	-	"
55.47	.37	1.570	"
	Results at 50.7°		
9.70	2.24	1.095	$CaHPO_4$
13.43	3.02	1.137	"
17.98	3.84	1.189	"
26.55	5.32	1.299	"
29.47	5.69	1.334	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
35.23	4.33	1.381	$Ca(H_2PO_4)_2 \cdot H_2O$
40.75	3.28	1.422	"
45.43	2.18	1.464	"
50.61	1.37	1.515	"
55.61	0.83	1.579	"
	Results at 80°		
9.45	1.66	1.066	$CaHPO_4$
13.05	2.39	1.112	"
21.85	3.87	1.203	"
27.20	4.66	1.276	"
36.30	5.65	1.382	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
41.55	4.37	1.439	$Ca(H_2PO_4)_2 \cdot H_2O$
44.98	3.60	1.462	"
51.96	2.27	1.538	"
56.54	1.69	1.581	"
	Results at 95°		
30.56	4.79	1.308	$CaHPO_4$
35.29	5.32	1.358	"
40.04	5.60	1.422	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
45.00	4.21	1.460	$Ca(H_2PO_4)_2 \cdot H_2O$
49.13	3.33	1.512	"

Devyatin, 1940 determined the solubility of $Ca_3(PO_4)_2$, $CaHPO_4$, and $Ca(H_2PO_4)_2$ in water and in 0.2 and 1.0 NK_2CO_3 solution, cold and at the boiling point.

SOLUBILITY OF CALCIUM PHOSPHATES IN PHOSPHORIC ACID SOLUTIONS AT VARIOUS TEMPERATURES

(Elmore and Farr, 1940)

The results are in excellent agreement with those of Bassett (Vol. I, p. 321) and of Belopolski, et al (Above).

Gms. P_2O_5 per 100 gms. Sat. Sol.	Gms. CaO per 100 gms. Sat. Sol.	Density	Solid Phase
		Results at 25°	
24.10	5.785	1.3018	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
34.94	3.411	1.3795	$Ca(H_2PO_4)_2 \cdot H_2O$
38.53	2.621	1.4112	"
39.97	2.307	1.4216	"
41.48	2.008	1.4360	"
43.05	1.708	1.4506	"
45.03	1.365	1.4700	"
46.97	1.064	-	"
50.26	0.695	1.5307	"
53.04	.475	1.5676	"
56.44	.320	1.6143	"
59.21	.249	1.6549	"
61.66	.201	1.6932	$Ca(H_2PO_4)_2 \cdot H_2O + Ca(H_2PO_4)_2$
62.56	.190	1.7090	$Ca(H_2PO_4)_2$
65.55	.090	1.7522	"
70.24	.051	-	"
70.42	.054	1.8406	"
		Results at 40°	
21.48	4.760	1.2480	$CaHPO_4$
26.47	5.785	-	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
35.08	3.922	-	$Ca(H_2PO_4)_2 \cdot H_2O$
39.76	2.825	1.4206	"
47.55	1.376	1.4998	"
47.69	1.371	1.4964	"
50.89	0.923	1.5400	"
52.25	.737	1.5604	"
53.90	.621	1.5823	"
57.40	.441	1.6338	"
57.64	.437	1.6365	"
58.32	.414	1.6376	"
62.30	.205	1.6960	$Ca(H_2PO_4)_2 \cdot H_2O + Ca(H_2PO_4)_2$
61.94	.214	1.6917	"
62.64	.195	1.7016	"
65.76	.120	1.7548	$Ca(H_2PO_4)_2$
65.35	.084	1.8206	"
		Results at 75°	
3.23	0.748	1.007	$CaHPO_4$
10.14	1.963	1.080	"
16.96	3.165	1.159	"
23.95	4.337	1.246	"
32.47	5.387	1.357	"
37.21	4.980	1.399	$Ca(H_2PO_4)_2 \cdot H_2O$
40.18	4.276	1.428	"
41.57	3.964	1.440	"

Gms. P_2O_5 per 100 Gms. Sat. Sol.	Gms. CaO per 100 gms. Sat. Sol.	Density	Solid Phase
		Results at 75° (Con.)	
42.71	3.676	1.449	$Ca(H_2PO_4)_2 \cdot H_2O$
44.03	3.356	1.461	"
45.91	2.986	1.482	"
47.72	2.622	1.496	"
50.31	2.152	1.526	"
53.16	1.731	1.557	"
55.97	1.408	1.595	"
58.25	0.999	1.624	$Ca(H_2PO_4)_2$
60.68	.693	1.654	"
64.96	.379	1.718	"
70.12	.267	1.806	"
		Results at 100°	
5.04	0.871	1.0143	$CaHPO_4$
14.90	2.407	1.107	"
24.70	3.958	1.224	"
32.89	4.996	1.332	"
33.88	5.117	1.342	"
40.15	5.529	1.432	$CaHPO_4 + Ca(H_2PO_4)_2 \cdot H_2O$
40.80	5.432	1.438	$Ca(H_2PO_4)_2 \cdot H_2O$
41.67	5.183	1.416	"
45.37	4.301	1.476	"
49.76	3.411	1.519	"
52.91	2.822	1.554	"
53.57	2.719	1.564	"
55.48	2.479	1.583	"
57.15	1.871	1.599	$Ca(H_2PO_4)_2$
58.00	1.703	1.610	"
59.22	1.489	1.623	"
61.48	1.127	1.651	"
65.36	0.719	1.708	"
70.04	0.584	1.791	"

Klement and Weber, 1941 determined the solubility of Hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$ in water and aqueous solutions at 25°.

Additional data on the system $CaO - H_3PO_4 - H_2O$ (at 26°) in the presence of Kaolinite and Ferric Oxide are given by Mebane, 1940.

The solubilities of various soil phosphates in HCl and NH_3 solutions under various conditions were determined by Fraps, 1911.

SOLUBILITY OF CALCIUM PHOSPHATE AND CALCIUM SULFATE AT 75.3° - EQUILIBRIUM IN THE SYSTEM $CaO - P_2O_5 - SO_3 - H_2O$

(Campbell and Coutts, 1948)

The solubility relationships in the system $CaO + P_2O_5 + H_2O$ are changed to a very small extent upon the addition of SO_3. As the concentration of P_2O_5 increases, the solubility of $CaSO_4$ in the solution becomes negligibly small. The results agree well with those of Elmore and Farr (Above). The phases were identified by optical examination.

Gms. per 100 gms. Saturated Solution			Solid Phase
CaO	P_2O_5	SO_3	
0.109	0.294	0.151	$Ca_3(PO_4)_2 \cdot H_2O + CaHPO_4 + CaSO_4 \cdot 2H_2O$
.122	.310	.154	"
.118	.283	.157	"
.281	.976	.141	$CaHPO_4 + CaSO_4 \cdot 2H_2O + CaSO_4$ (Trace)
.741	3.07	.157	$CaHPO_4 + CaSO_4 \cdot 2H_2O$
2.01	9.49	.125	"
2.68	13.35	.091	"
3.49	18.09	.075	"
3.94	20.93	.081	"
4.92	27.51	.052	"
PO 5.27	30.53	.048	$CaHPO_4 + CaSO_4 \cdot 2H_2O + CaSO_4 \cdot \frac{1}{2}H_2O$
5.37	31.68	-	$CaHPO_4 + CaSO_4 \cdot 2H_2O$
5.45	32.72	.050	$CaHPO_4 + CaSO_4 \cdot \frac{1}{2}H_2O$
5.52	33.54	.035	"
5.64	35.51	.033	$CaHPO_4 + CaSO_4 \cdot \frac{1}{2}H_2O + Ca(H_2PO_4)_2 \cdot H_2O$
5.68	35.60	.028	"
5.38	36.54	.035	$Ca(H_2PO_4)_2 \cdot H_2O + CaSO_4 \cdot \frac{1}{2}H_2O$
5.10	37.60	.026	"
4.35	40.62	.018	"
3.30	44.63	.017	"
2.96	46.00	Trace	"
2.40	49.02	-	"
1.65	54.24	-	"
1.275	57.46	-	$Ca(H_2PO_4)_2 \cdot H_2O + CaSO_4 \cdot \frac{1}{2}H_2O + Ca(H_2PO_4)_2$ (Trace)
1.269	57.38	-	"
1.150	57.47	-	"

For data on the solubility of Calcium Phosphates in Calcium Nitrate solutions look under $Ca(NO_3)_2$.

SOLUBILITY OF CALCIUM PHOSPHATES IN ACIDS AND BASES

(Ghani and Aleem, 1942)

The authors shook 10 mg. of $Ca_3(PO_4)_2$, $Ca(H_2PO_4)_2$, $CaHPO_4$ and Apatite at room temperature for two hours with 0.5 N Acetic Acid, 0.25 N NaOH, and 2N H_2SO_4, and report the milligrams of P_2O_5 dissolved in the volume of solvent used. These figures were recalculated to the form below:

Solvent	Mg. Dissolved in 100 ml.			
	$Ca_3(PO_4)_2$	$CaHPO_4$	$Ca(H_2PO_4)_2$	Apatite
0.5 N CH_3COOH	3.7	>4	>4	2.5
0.25 N NaOH	0.06	0.6	1.4	Trace
2 N H_2SO_4	>4	>4	>4	3.6

Values indicated as >4 mean that the entire sample dissolved in the volume of solvent used.

Greenwald (1945) shows that the solubility of Tri-Calcium Phosphate is increased by the presence of Bicarbonate ions, and that the solubility of Calcium Phosphate in Sodium Chloride Solutions and in Serum Salt Solutions of the same ionic strength is the same. These findings explain the results of Holt, LaMer, and Chown and of Sendroy and Hastings (Vol. I, p. 319) on the solubility in serum and in salt solutions.

Data for the system $CaO - P_2O_5 - HCl - H_2O$ are given by Taperova and Shulgina, 1946.

Greenwald (1942) determined the solubility of Tri-Calcium Phosphate and found that the apparant solubility product increased with increasing amounts of solid phase present, and also with increasing pH. This is contrary to the findings of Logan and Taylor (Vol. I, p. 320) and it is shown that the opposite result which was obtained by these authors may have been caused by supersaturation.

Eisenberger, Lehrman and Turner (1940) present a review of the system $CaO - P_2O_5 - H_2O$ and conclude that Tricalcium Phosphate and Hydroxyapatite do not exist in aqueous solutions as unique, stoichiometric compounds, but that a series of solid solutions exists in the ternary system between the compositions $CaHPO_4$ and CaO which have the Apatite Lattice. The compound $Ca_3(PO_4)_2$ thus represents only one point in a continuous range of possible compositions.

Rae and Clegg (1948) report the solubility of Ca_3PO_4, tooth enamel and whole teeth in 1% Lactic Acid Solutions, alone and in the presence of added salts. The results are expressed in terms of loss in weight of the starting material, and the mg. of Ca and P in solution. NaF, $(NH_4)_2C_2O_4$, $Pb(NO_3)_2$, $Ba(NO_3)_2$, $AgNO_3$ and AgF were used as added salts and the "protective effect" of a second precipitate on the original Calcium Phosphate was studied in 0.01 - 0.05 M solutions, which reduced the solubility of Calcium Phosphate to as little as 1/6 the amount which dissolved in Lactic Acid alone. PC

Logan and Kane (1939) report on the amounts of Calcium Phosphate in solution in equilibrium with young and old bones and find a decrease with increasing amounts of solid bone added. Some difficulties were encountered because of the protein material which was present. Also see Greenwald (1942) (Above).

SOLUBILITY OF CALCIUM PHOSPHATE IN CITRIC ACID SOLUTIONS

(Maurice, 1939)

The author gives curves showing the relative solubility of $Ca_3(PO_4)_2$ and natural phosphates in various concentrations of Citric Acid (up to 1%). The $Ca_3(PO_4)_2$ used was about four times as soluble as the Apatite used, as measured by the P_2O_5 content of the solutions. The solubility of $Ca_3(PO_4)_2$ in different volumes of 1% Citric Acid was determined with varying amounts of $CaCO_3$ added. No temperature is given. The data below were read from the curves.

Gms. $CaCO_3$ Added per gm. $Ca_3(PO_4)_2$	Mg. P_2O_5 per 100 ml. Sat. Sol.	Mg. P_2O_5 per 200 ml. Sat. Sol.	Mg. P_2O_5 per 300 ml. Sat. Sol.
0.0	340	570	800
.200	225	470	680
.400	150	400	600
.600	80	300	500
.800	60	230	400
1.000	50	200	340

The effect of added oxides: Al_2O_3, SiO_2, Fe_2O_3 on the solubility of various mixtures of $CaO + P_2O_5$ in Ammonium Citrate Solutions (solubility decreases) was determined by Frear, Deese and Lefforge (1944). It was found that crystalline $CaO + P_2O_5$ samples had a lower solubility than ones which were glass-like. The effect of the added oxides on the hygroscopicity and fusibility was also studied.

The solubility of Calcium Phosphate in Sea Water is given by Dietz, Emery and Shepherd, 1942.

A detailed study of the system P_2O_5 + $2CaO \cdot P_2O_5$ by the quenching method was made by Hill, Faust, and Reynolds (1944).

Bredig (1943) gives the diagram of Ca_2SiO_4 + $Ca_3(PO_4)_2$ from crystal structure data.

S CALCIUM SULFIDE CaS

Melting points have been determined for:

CaS + FeS Heumann (1942), Vogel and Heumann (1941).
CaS + Fe Vogel and Heumann (1941).

SO_4 CALCIUM SULFATE $CaSO_4$

SOLUBILITY OF CALCIUM SULFATE IN WATER
(Sborgi and Bianchi, 1940)

The authors determined the solubility of $CaSO_4 \cdot \frac{1}{2}H_2O$ in Water by a determination of the conductivity of the solutions. The results are in fairly good agreement with those of Chassevent (Vol. I, p. 328), and are probably more accurate below 15°, where Chassevent's curve falls off sharply because of experimental difficulties.

Sborgi and Bianchi also give data for the solubility of $CaSO_4$ in the form of the "Soluble Anhydrite", which solubility parallels that of the hemihydrate, but is smaller at all temperatures. However, when the authors tested the effect of the time and temperature of dehydration on the solubility of Anhydrite (containing analytically 0.01 - 0.02% H_2O) they found the solubility of their product to be 0.840% at 20° [method not given] regardless of the conditions used during dehydration. This result agrees with the solubility found by Chavassent and the authors for $CaSO_4 \cdot \frac{1}{2}H_2O$.

	Hemihydrate	Anhydrite		Hemihydrate	Anhydrite
t°	Gms. $CaSO_4$ per 100 gms. Sat. Sol.	Gms. $CaSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $CaSO_4$ per 100 gms. Sat. Sol.	Gms. $CaSO_4$ per 100 gms. Sat. Sol.
0	(1.23)	-	35	0.603	0.534
5	1.10	1.05	40	.550	.48
10	(0.98)	-	50	.47	.41
15	(.88)	-	75	.29	.266
18	.82	0.72	100	.189	.151
25	.71	.63	110	.151	.139

( ) = Interpolated

SOLUBILITY OF CALCIUM SULFATE IN SEA WATER AT 30°

(Posojak, 1940)

The author determined the solubility of $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ in "Normal" Sea Water which was prepared in the laboratory and was the average composition of Sea Water throughout the world, as found by Dittmar (1884). The composition of "Normal" Sea Water in grams per 1000 gms. H_2O is:

NaCl	27.21	K_2SO_4	0.863
$MgCl_2$	3.81	$CaCO_3$	.123
$MgSO_4$	1.66	$MgBr_2$	.076
$CaSO_4$	1.260	+ Minor amounts of other salts.	

The author's solvent contained NaCl, $MgCl_2$, $MgSO_4$ and K_2SO_4. Data are given in terms of gms. $CaSO_4$ per 100 gms. H_2O.

SO

Concentration* of Sea Salts	Solid Phase		Concentration of Sea Salts	Solid Phase	
	$CaSO_4 \cdot 2H_2O$	$CaSO_4$		$CaSO_4 \cdot 2H_2O$	$CaSO_4$
0.0	0.209	0.250	3.0	0.432	0.470
0.5	.366	.414	3.6	.412	.436
1.0	.418	.468	5.0	.339	.336
2.0	.449	.488	5.5	.308	.288

* Equals the number of times the "Normal" salt concentration present. E.G. 1.0 = "Normal" Sea Water, 3.0 = Salt concentrations 3 times that in "Normal" Sea Water.

The precipitation of $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ during Sea Water evaporation is discussed.

Gilliert and Gilpin (1946) determined the solubility of Calcium Sulfate in Sea Water after the Magnesium Salts had been partially precipitated as $Mg(OH)_2$ by the addition of Lime.

For data on the solubility of $CaSO_4$ + $Ca(OH)_2$ in solutions of K_2O and Na_2O see Hansen and Pressler under $Ca(OH)_2$ (Page 130.)

SOLUBILITY OF $CaSO_4 \cdot 2H_2O$ IN SOLUTIONS OF HCl + $CaCl_2$ AT 20°

(Kuznetzov, 1946)

Solvent Wt. %		Gms. $CaSO_4$ per 1000 gms. Sat. Sol.	Solvent Wt. %		Gms. $CaSO_4$ per 100 gms. Sat. Sol.
HCl	$CaCl_2$		HCl	$CaCl_2$	
20.0	0.0	12.64	4.0	20.0	0.47
16.0	5.0	2.63	4.0	15.0	0.93
16.0	0.0	16.11	4.0	10.0	1.89
12.0	10.0	1.46	4.0	5.0	4.20
12.0	5.0	3.97	4.0	0.0	15.75
12.0	0.0	18.78	0.0	25.0	0.17
8.0	15.0	0.93	0.0	20.0	0.29
8.0	10.0	1.98	0.0	15.0	0.47
8.0	5.0	4.85	0.0	10.0	0.69
8.0	0.0	19.80	0.0	5.0	0.99
			0.0	0.0	2.08

SOLUBILITY OF CALCIUM SULFATE IN CHROMIC ACID SOLUTIONS

(Ryss, Zajarnij, and Zeljanskaja, 1941)

Gms CrO_3 per 100 gms. H_2O	Gms. $CaSO_4$ per 100 gms. H_2O	Solid Phase
Results at 25°		
2.677	0.684	$CaSO_4 \cdot 2H_2O$
6.76	1.14	"
17.11	2.13	"
26.48	2.332	"
27.01	2.29	"
27.21	2.332	"
37.40	2.232	"
41.90	2.204	"
79.82	1.445	"
95.20	1.260	"
116.3	1.106	"
131.1	0.826	"
166.0	.675	$CaSO_4 \cdot 2H_2O + CrO_3$
169.6	.678	"
Results at 60°		
2.37	0.994	$CaSO_4 \cdot 2H_2O$
3.758	1.44	"
8.982	2.35	"
14.26	2.93	"
15.45	3.16	"
22.95	3.66	"
24.61	3.70	"
27.68	3.72	"
31.43	3.77	"
49.10	3.74	$CaSO_4 \cdot 2H_2O$
50.19	3.63	"
57.62	3.40	"
72.07	2.85	"
90.46	1.79	$CaSO_4$
139.2	0.842	"
168.74	0.511	"
176.2	0.503	$CaSO_4 + CrO_3$
176.2	0.502	"
Results at 95°		
1.493	1.021	$CaSO_4$
5.043	2.50	"
10.55	3.75	"
17.16	3.96	"
25.47	3.95	"
31.81	3.81	"
83.20	2.32	"
90.62	2.16	"
98.45	1.94	"
107.20	1.80	"
144.1	1.233	"
200.3	0.517	$CaSO_4 + CrO_3$
201.1	0.531	"
Result at approximately 24° (20°-26°)		
30.56	2.36	$CaSO_4 \cdot 2H_2O$

SOLUBILITY OF CALCIUM SULFATE IN PHOSPHORIC ACID SOLUTIONS

(Taperova, 1940)

Gms. per 100 gms. Sat. Sol. P_2O_5	Gms. per 100 gms. Sat. Sol. $CaSO_4$	Density
Results at 25°		
Solid Phase $CaSO_4$		
0.0	0.27	1.006
8.24	.73	1.071
21.05	.75	1.175
24.82	.66	1.201
31.33	.51	1.273
35.04	.39	1.310
42.40	.27	-
44.77	.23	1.449
46.57	.16	1.470
48.80	.12	1.478
55.56	.02	1.914
63.51	Trace	-
Solid Phase $CaSO_4 \cdot \frac{1}{2}H_2O$		
36.80	0.80	-
41.13	.57	1.377
47.00	.32	1.445
51.20	.20	1.519
56.06	.09	1.520
61.15	.08	1.633

Gms. per 100 gms. Sat. Sol. P_2O_5	Gms. per 100 gms. Sat. Sol. $CaSO_4$	Density	Gms. per 100 gms. Sat. Sol. P_2O_5	Gms. per 100 gms. Sat. Sol. $CaSO_4$	Density

Results at 25° (Con.)

Solid Phase $CaSO_4 \cdot 2H_2O$

0.0	0.20	1.007	25.39	.61	1.220
4.70	.51	1.035	29.65	.56	1.273
4.77	.46	1.035	31.54	.53	1.292
8.24	.58	1.070	34.14	.49	1.314
10.07	.62	1.079	39.40	.39	1.385
19.99	.68	1.150	44.48	.32	1.444
18.37	.70	1.148	46.70	.29	1.490
18.80	.70	1.164	47.60	.28	1.500
19.43	.58	1.171	51.22	.22	1.520
25.09	.66	1.215	55.00	.17	1.530

Results at 80°

Solid Phase $CaSO_4$

0.0	0.17	1.00
1.97	.44	1.004
2.92	.51	1.009
3.91	.58	1.024
4.93	.58	1.029
5.88	.68	1.088
6.78	.88	1.050
8.08	1.00	1.065
16.00	1.09	1.127
30.65	0.85	1.274
31.49	.92	1.283
32.24	.80	1.292
40.80	.51	1.395
41.30	.58	1.400
41.60	.54	1.404
54.70	.17	1.585
56.43	.10	1.615
61.63	Trace	1.693

Solid Phase $CaSO_4 \cdot \frac{1}{2}H_2O$

24.80	1.615	1.200
28.50	1.52	1.239
29.00	1.53	1.250
31.48	1.42	1.269
33.86	1.29	1.299
38.30	1.06	1.360
40.01	0.90	1.365
40.00	.91	1.365
42.00	.85	1.399

Solid Phase $CaSO_4 \cdot 2H_2O$

0.0	0.19	1.00
1.00	.44	1.00
1.97	.58	1.004
2.15	.56	1.005
2.92	.66	1.008
3.91	.75	1.024
4.98	.83	1.028
5.88	.88	1.038
6.78	.95	1.050
7.78	1.02	1.060
8.11	1.17	1.065
10.40	1.22	1.077
12.53	1.34	1.090
14.02	1.31	1.098
18.18	1.40	1.140
20.00	1.44	1.160
20.50	1.41	1.160
22.60	1.41	1.180
25.00	1.28	1.210
25.20	1.40	1.210
30.34	1.31	1.260
30.48	1.35	1.260
34.46	1.26	1.320
35.50	1.26	1.320
35.50	1.28	1.320
40.01	1.11	1.380
44.46	0.95	1.430

$CaSO_4$ is 4.5 times as soluble in 3N $NaNO_3$ solution as in pure water. (Belfiori, 1940)

SOLUBILITY OF CALCIUM SULFATE IN PHOSPHORIC ACID SOLUTIONS

(Taperova and Sh.u lgina, 1945)

The results agree fairly well with those of Sanfourche and Krapavine, but not with those of D'Ans and Hofer (Vol. I, p. 332 - 333). Viscosities were also determined.

Density	Gms. P_2O_5 per 100 gms Sat. Sol.	Gms. P_2O_5 per liter Sat. Sol.	Solid Phase: $CaSO_4$ Gms. per 100 gms. Sat. Sol.	$CaSO_4$ Gms. per liter Sat. Sol.	$CaSO_4 \cdot \frac{1}{2}H_2O$ Gms. per 100 gms. Sat. Sol.	$CaSO_4 \cdot \frac{1}{2}H_2O$ Gms. per liter Sat. Sol.	$CaSO_4 \cdot 2H_2O$ Gms. per 100 gms. Sat. Sol.	$CaSO_4 \cdot 2H_2O$ Gms. per liter Sat. Sol.
SO				Results at 40°				
1.2753	30	382.59	0.67	8.55	1.07	13.65	0.80	10.20
1.3312	35	465.92	.55	7.33	0.85	11.32	.68	9.05
1.3836	40	553.44	.36	4.98	.63	8.72	.53	7.33
1.4424	45	649.08	.27	3.89	.47	6.78	.46	6.64
1.5130	50	756.50	.18	2.73	.30	4.54	.39	5.90
				Results at 60°				
1.2342	25	308.55	0.85	8.16	1.44	17.67	1.05	12.94
1.2841	30	382.23	.75	9.63	1.23	15.79	0.98	12.58
1.3274	35	464.59	.62	8.24	1.02	13.54	.88	11.68
1.3786	40	551.44	.48	6.62	0.79	10.89	.79	10.89
1.4412	45	648.54	.32	4.62	.58	8.36	.69	9.94
1.5007	48.5	727.83	-	-	.39	5.85	-	-
1.5104	50	755.20	.26	3.93	.35	5.29	.54	8.15

SOLUBILITY OF CALCIUM SULFATE IN AQUEOUS SOLUTIONS OF POTASSIUM SULFATE ALONE AND CONTAINING HNO_3 OR KOH AT 19°

(Golovatyj, 1940)

The temperature varied from 18° to 20°. The solvents used were K_2SO_4 solutions, and solutions of K_2SO_4 + HNO_3 and K_2SO_4 + KOH as listed below. The solubility of Calcium Sulfate is given in terms of gms. $CaSO_4$ per liter of solvent.

Gm. Equiv K_2SO_4 per liter of Solvent	Gms. K_2SO_4 per liter of Solvent	0.1 N HNO_3	0.05 N HNO_3	0.01 N HNO_3	H_2O	0.01 N KOH	0.05 N KOH	0.1 N KOH
0.0	0.0	3.869	3.042	2.630	2.169	2.169	2.428	1.474
0.004	.349	3.800	2.973	2.537	1.992	2.358	2.352	1.488
.008	.697	3.790	2.676	2.448	1.815	2.398	2.305	1.542
.016	1.394	3.512	2.578	2.320	1.474	2.292	2.293	1.461
.032	2.788	3.386	2.428	2.238	1.315	2.265	2.235	1.680
.064	5.576	3.228	2.400	2.156	1.196	2.097	2.197	1.849
.128	11.153	3.102	2.285	2.156	1.393	2.163	2.155	1.883
.256	22.305	2.925	2.048	2.002	1.681	2.129	2.156	1.827

SOLUBILITY OF CALCIUM SULFATE IN SODIUM CHLORIDE SOLUTIONS AT 25°

(Shternina, 1948)

The data agree with those of other authors (Vol. I, p. 340) above 12 gms. NaCl per 100 cc of solution, but at lower concentrations the results are larger than those previously reported.

Gms. NaCl per 100 cc Sat. Sol.	Gms. $CaSO_4$ per 100 cc Sat. Sol.	Gms. NaCl per 100 cc Sat. Sol.	Gms. $CaSO_4$ per 100 cc Sat. Sol.
1.981	0.431	16.816	0.716
5.003	.600	18.073	.706
8.610	.687	23.152	.665
11.988	.722	28.348	.610
13.876	.724	31.721	.582
15.215	.723		

SO

SOLUBILITY OF CALCIUM SULFATE IN CALCIUM CHLORIDE - HYDROCHLORIC ACID SOLUTIONS at 20°

(Kuznetsov, 1946)

Composition of Solvent		Gms. $CaSO_4$ per 1000 gms. Sat. Sol.	Composition of Solvent		Gms. $CaSO_4$ per 1000 gms. Sat. Sol.
% HCl	% $CaCl_2$		% HCl	% $CaCl_2$	
20.0	-	12.64	4.0	20.0	0.47
16.0	5.0	2.63	4.0	15.0	0.93
16.0	-	16.11	4.0	10.0	1.89
12.0	10.0	1.46	4.0	5.0	4.20
12.0	5.0	3.97	4.0	-	15.75
12.0	-	18.78	-	25.0	0.17
8.0	15.0	0.93	-	20.0	.29
8.0	10.0	1.98	-	15.0	.47
8.0	5.0	4.85	-	10.0	.69
8.0	-	19.80	-	5.0	.99
			-	-	2.08

EQUILIBRIUM IN THE SYSTEM CALCIUM SULFATE - UREA - WATER

(Ono, 1940)

Gms. $CO(NH_2)_2$ per 100 gms Sat. Sol.	Gms. $CaSO_4$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 0°	
40.12	0.0	$CO(NH_2)_2$
40.05	1.17	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
38.91	1.14	$4CO(NH_2)_2 \cdot CaSO_4$
35.51	1.31	$4CO(NH_2)_2 \cdot CaSO_4 + CaSO_4 \cdot 2H_2O$
30.57	0.87	$CaSO_4 \cdot 2H_2O$
24.35	.71	"
0.0	.17	"
	Results at 20°	
51.15	0.0	$CO(NH_2)_2$
51.43	1.09	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
51.30	1.05	$4CO(NH_2)_2 \cdot CaSO_4$
51.10	1.14	"
49.29	1.17	"
46.44	1.23	$4CO(NH_2)_2 \cdot CaSO_4 + CaSO_4 \cdot 2H_2O$
44.28	1.03	$CaSO_4 \cdot 2H_2O$
39.66	0.93	"
36.63	.75	"
30.82	.63	"
19.98	.46	"
0.0	.20	"

Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Gms. $CaSO_4$ per 100 gms. Sat. Sol.	Solid Phase
Results at 30°		
55.63	0.0	$CO(NH_2)_2$
55.50	1.03	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
55.30	1.08	$4CO(NH_2)_2 \cdot CaSO_4$
55.31	1.09	"
50.86	1.37	$4CO(NH_2)_2 \cdot CaSO_4 \cdot 2H_2O$
40.98	1.21	$CaSO_4 \cdot 2H_2O$
39.78	1.02	"
38.86	0.76	"
34.01	.88	"
15.05	.35	"
14.35	.35	"
0.0	.21	"
Results at 40°		
63.32	0.0	$CO(NH_2)_2$
62.47	1.14	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
61.70	1.20	$4CO(NH_2)_2 \cdot CaSO_4$
58.61	1.22	"
57.2	1.40	$4CO(NH_2)_2 \cdot CaSO_4 + CaSO_4 \cdot 2H_2O$
53.48	1.27	$CaSO_4 \cdot 2H_2O$
51.96	1.20	"
49.77	1.08	"
42.80	0.83	"
23.33	.35	"
0.0	.24	"
Results at 60°		
76.03	0.0	$CO(NH_2)_2$
76.27	1.37	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
75.04	1.29	$4CO(NH_2)_2 \cdot CaSO_4$
71.5	1.78	$4CO(NH_2)_2 \cdot CaSO_4 + CaSO_4 \cdot 2H_2O$
56.34	1.23	$CaSO_4 \cdot 2H_2O$
41.36	0.60	"
0.0	.30	"

SO

INVARIANT POINTS IN THE SYSTEM UREA - CALCIUM SULFATE - WATER

(Sakai, 1940)

The results differ considerably from those of Uno (above). Each figure is the average of several determinations.

Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Gms. $CaSO_4$ per 100 gms. Sat. Sol.	Solid Phase
Results at 25°		
54.5	0.0	$CO(NH_2)_2$
55.8	1.1	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
51.5	1.4	$4CO(NH_2)_2 \cdot CaSO_4 + CaSO_4 \cdot 2H_2O$
Results at 30°		
57.3	0.0	$CO(NH_2)_2$
61.4	1.2	$CO(NH_2)_2 + 4CO(NH_2)_2 \cdot CaSO_4$
55.5	1.2	$4CO(NH_2)_2 \cdot CaSO_4 + CaSO_4 \cdot H_2O$

For data on the solubility of Calcium Sulfate in solutions also saturated with Calcium Phosphate, see Campbell and Coutts, under Calcium Phosphate. (Page 133).

SOLUBILITY OF CALCIUM SULFATE IN GLYCINE SOLUTIONS AT 25°
(Lee and Luh, 1948)

The authors present data which is rather widely scattered when plotted on cross section paper. The following values were read from the curve and the estimated accuracy is ± 0.1 gms. $CaSO_4$ per 1000 gm. H_2O.

Gms. Glycine per 1000 gms. H_2O	Gms. $CaSO_4$ per 1000 gms. Sat. Sol.	Gms. Glycine per 1000 gms. H_2O	Gms. $CaSO_4$ per 1000 gms. Sat. Sol.
0.0	2.1	40.0	3.9
5.0	2.3	45.0	4.2
10.0	2.5	50.0	4.5
15.0	2.7	55.0	4.8
20.0	2.9	60.0	5.2
25.0	3.2	65.0	5.5
30.0	3.4	70.0	5.9
35.0	3.7	75.0	6.2

Data are given for the following systems:

$CaSO_4$ + NaCl (Bye and Kiehl, 1948)
$CaSO_4$ + $Na_2B_4O_7$ (Zhilenko and Sverchkov, 1940)
$CaSO_4$ + K_2SO_4 (Bellanca, 1942)
$CaSO_4$ + Na_2SO_4 (Bellanca, 1942; Bredig, 1942)
$CaSO_4$ + Na_2SO_4 + K_2SO_4 (Bellanca, 1942)

CALCIUM THIOSULFATE $CaS_2O_3 \cdot 6H_2O$ SO

SOLUBILITY OF CALCIUM THIOSULFATE IN WATER
(Silberman and Ivanov, 1946)

The authors' data were plotted, and the values at integral temperatures read from the curve (The solubility is a linear function of temperature in the interval studied). The authors' original data is marked (*). The solid phase was $CaS_2O_3 \cdot 6H_2O$ throughout.

t°	Gms. CaS_2O_3 per 100 gms. Sat. Sol.	t°	Gms. CaS_2O_3 per 100 gms. Sat. Sol.
0	25.75	20	33.05
5	27.60	25	34.90
*6	28.04	*25.5	34.88
*9	28.84	*29.9	36.77
10	29.40	30	36.75
*11.75	30.08	*34.5	38.48
15	31.25	35	38.60
*17.75	32.28	40	40.45

SON CALCIUM SULFAMATE $Ca(SO_3NH_2)_2$

SOLUBILITY OF CALCIUM SULFAMATE IN WATER
(King and Hooper, 1941)

The transition temperature $Ca(SO_3NH_2)_2 \cdot 4H_2O \rightleftharpoons Ca(SO_3NH_2)_2 + 4H_2O$ was found by the intersection of the solubility curves and by cooling curve determinations to be 69.40° ± 0.05°.

t°	Gms. $Ca(SO_3NH_2)_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $Ca(SO_3NH_2)_2$ per 100 gms. H_2O	Solid Phase
0.0	56.48	$Ca(SO_3NH_2)_2 \cdot 4H_2O$	69.40	-	$Ca(SO_3NH_2)_2 \cdot 4H_2O$ + $Ca(SO_3NH_2)_2$
10.0	62.76	"			
20.0	72.32	"	71.0	205.0	$Ca(SO_3NH_2)_2$
*25.0	78.0	"	72.5	206.7	"
30.0	84.47	"	75.0	208.7	"
40.0	100.1	"	80.0	215.2	"
50.0	120.3	"	83.4	220.4	"
60.0	150.0	"	88.7	229.3	"
65.0	173.5	"	95.0	242.7	"
68.0	191.8	"			

*Interpolated. Cupery (1938) found the solubility to be 67 gms. per 100 gms. of water at 25°

SeO CALCIUM SELENATE $CaSeO_4$

Dolique (1943) reports that 6.12 gms. $CaSeO_4$ dissolve in 100 ml. of water at 10°. This does not agree with the value found by Meyer and Aulich (About 8.2 gms.) (Vol. I, p. 345).

SiO CALCIUM SILICATE

THE SYSTEM $CaO + SiO_2 + H_2O$ AT 30.2°
(Roller and Ervin, 1940)

The authors found that equilibrium could be attained in from 3 hours to 2 days when varying concentrations of lime water were added to a hydrous Calcium Silicate Precipitate. Equilibrium was approached from both undersaturation and supersaturation, and separate analyses were made for CaO and SiO_2 on the solid and the solution. The reagents were pure and free of CO_2. Data are given for the concentration of Calcium in equilibrium with solids of varying CaO/SiO_2 ratios, and two solutions of invariant composition were found. The nature of the solid phases were determined by assuming that the varying composition of the solids was due to the absorption of CaO from the solution by certain definite compounds of $CaO + SiO_2$ in the solid, and not just solid solutions $CaO \cdot ySiO_2$. When various compounds were assumed as the absorbant and the moles CaO absorbed per mole of compound were plotted for different solutions, it was found that straight lines (Freundlich equation curves) were obtained for the compounds $CaO \cdot SiO_2$ and $3CaO \cdot 4SiO_2$. The existence of these compounds did not exclude the possibility of others, but their existence was confirmed by testing the product of their ionic concentrations, or activities, for constancy. By this means the formulas were found to be CaH_2SiO_4 and $Ca_3(HSi_2O_6)_2$, and in the latter case only the dimeric $HSi_2O_6^{=}$ was possible. The solubility products and ionization constants were calculated. The authors refer to other work on the system which supports their work.

Millimols Ca^{++} per liter	Moles CaO / Moles SiO_2	Solid Phase
20.67	1.401	CaH_2SiO_4 (+ Absorbed CaO)
19.96	1.447	"
19.90	1.417	"
19.60	1.427	"
17.51	1.387	"
14.98	1.326	"
13.53	1.309	"
12.08	1.267	"
9.81	1.235	"
7.49	1.187	"
6.99	1.168	"
6.60	1.164	"
4.89	1.116	"
4.02	1.110	"
3.11	1.053	CaH_2SiO_4 + $Ca_3(HSi_2O_6)_2$
3.10	1.048	"
3.05	1.008	"
3.11	1.014	"
3.07	1.000	"
Av.3.09	(0.090 SiO_2)	"
2.84	0.955	$Ca_3(HSi_2O_6)_2$ (+ Absorbed CaO)
2.69	.957	"
2.57	.955	"
2.24	.964	"
2.09	.936	"
2.07	.933	"
1.64	.910	"
1.60	.918	"
1.60	.919	"
1.37	.921	"
1.18	.901	"
0.990	.895	$Ca_3(HSi_2O_6)_2$ + $CaO \cdot 2SiO_2 \cdot H_2O$
.897	.869	"
.923	.854	"
.900	.852	"
.900	.819	"
Av..900	(0.931 SiO_2)	"

Bessey, 1938 discusses the system $CaO - SiO_2 - H_2O$ and gives a summary of the known hydrates of Calcium Silicate. The discussion is continued by Cirilli, 1939.

Krasilnikov and Kiselev, 1944 studied the absorption of CaO on Silica Gel and allowed up to 17 months for equilibrium. They concluded that absorption took place at first, and that the compound $CaO \cdot SiO_2 \cdot H_2O$ was formed. This agrees with Roller and Ervin (above). Curves are given and compared to those of other authors, but no numerical tables are included.

Melting point relationships have been determined for:

$CaAl_2SiO_7 + NaAlSiO_4$	(Smalley, 1947)
$CaSiO_3 + NaSiO_3 + NaAlSiO_4$	(Spivak, 1944)
$CaSiO_3 + CaAlSi_2O_8 + NaAlSiO_4$	(Gummer, 1943)
$CaSiO_3 + NaAlSi_3O_8 + NaAlSiO_4$	(Foster, 1942)
$CaSiO_3$ + Diopside + Anorthite	(Osborn, 1942)
$CaSiO_3$ + Diopside	(Schairer and Bowen, 1942)
$CaSiO_3$ + Akermanite	" " " "

CALCIUM TUNGSTATE $CaWO_4$

At 25°, 0.0323 gms. $CaWO_4$ are dissolved in one liter of a saturated solution in water. (Berkem, 1943). This agrees with the value 0.0268 gms. per liter at 18°, previously reported (Vol. I, p. 347). Both Values obtained from conductivity measurements.

C COLUMBIUM CARBIDE CbC

Columbium Carbide forms continuous solid solutions with Titanium and Zirconium Carbides.

Koval'skii and Umanskii, 1946

Cl COLUMBIUM CHLORIDE $CbCl_5$

SOLUBILITY OF COLUMBIUM CHLORIDE IN TITANIUM CHLORIDE
(Tarasenkov and Komandin, 1940)

	25°	50°	100°
Gms. $CbCl_5$ per 100 gms. Sat. Sol.	0.24	0.58	1.32

Cd CADMIUM Cd

The solubilities of Cadmium and other metals in mixtures of their molten salts have been determined for the following:

Cd in $CdCl_2$ at 700° (11)
Cd in KCl (0.042 wt. %) at 700° (11)
Cd in NaCl at 700° (11)
Cd in $CdCl_2$ + KCl at 700° (11)
Cd + Pb in $CdCl_2$ + $PbCl_2$ at 600° (1) (4) (5)
Cd + Pb in CdI_2 + PbI_2 at 500° (1)
Cd + Pb in $CdBr_2$ + $PbBr_2$ at 600° (1) (3)
Cd + Pb in $CdBr_2$ + $PbBr_2$ at 360° in mixtures of $AlBr_3$ + KBr (2)
Cd + Sn in $CdBr_2$ + $SnBr_2$ at 360° in mixtures of $AlBr_3$ + KBr (2) (6)
Cd + Sn in $CdCl_2$ + $SnCl_2$ at 600° (7) (8)
Cd + Tl in $CdCl_2$ + Tl_2Cl_2 at 460° and 600° (10)
Cd + Zn in $CdCl_2$ + $ZnCl_2$ at 500° and 600° (9)
Cd + Zn in $CdBr_2$ + $ZnBr_2$ at 450° and 550° (9)

(1) Hewsky and Jellinek (1933), (2) Delimarskii (1941), (3) Lorenz and Hering (1928), (4) Lorenz, Fraenkel, and Silberstein (1923), (5) Korber and Oelsen (1932), (6) Delimarskii and Miroshnichenko (1940), (7) Lorenz, Fraenkel, and Wolff (1928), (8) Lorenz (1924), (9) Jellinek and Siewers (1932), (10) Lorenz, Fraenkel, and Silberstein (1924), (11) Karpachev and Stromberg (1939).

Br CADMIUM BROMIDE $CdBr_2$

EQUILIBRIUM IN THE SYSTEM CADMIUM BROMIDE - CADMIUM CHLORIDE - WATER
(Benrath and Lechner, 1940)

At different temperatures and compositions, the solid solution between the salts had different degrees of hydration. These were 0, 1, 5/2, and 4 mols. of water per mol. of salts. There is no solution at any temperature which is simultaneously saturated with both the 0 and 5/2 hydrated solid solutions, but all the other possible pairs may coexist under the proper conditions.

x = Mols. $CdBr_2$ per mol. of water free salt mixture
m = Mols. H_2O per mol. of water free salt mixture

Solution					Solid		
Wt. % $CdCl_2$	Wt. % $CdBr_2$	x	m	Density	x	m	Composition
			Results at 25°				
54.9	0.0	0.0	8.37	1.787	-	-	$CdCl_2 \cdot 5H_2O$
54.2	1.24	1.51	8.25	1.800	0.33	2.87	S.S. $\cdot \frac{5}{2}H_2O$
51.7	4.78	5.86	8.07	1.843	1.70	2.44	"
44.4	14.07	17.60	7.86	1.903	14.81	4.01	"
40.6	18.49	23.5	7.86	1.922	18.92	3.70	"
-	-	26.0	7.9	-	-	-	S.S. $\frac{5}{2}H_2O$ + S.S. $\cdot 4H_2O$
32.7	26.5	35.2	8.22	1.938	37.7	3.96	S.S. $\cdot 4H_2O$
26.3	32.5	45.4	8.74	1.934	47.5	4.74	"
14.56	43.4	66.0	10.31	1.902	71.1	4.00	"
6.78	47.9	82.6	11.80	1.838	90.0	4.98	"
3.26	50.8	91.3	12.51	1.810	96.6	4.94	"
0.0	52.9	100.	13.50	1.785	-	-	$CdBr_2 \cdot 4H_2O$
			Results at 30°				
56.2	0.0	0.0	7.95	1.827	-	-	$CdCl_2 \cdot 5H_2O$
51.9	5.57	6.74	7.79	1.857	0.61	2.59	S.S. $\cdot \frac{5}{2}H_2O$
52.7	6.42	7.58	7.31	1.915	4.24	2.00	"
47.6	11.74	14.24	7.46	1.939	13.45	2.95	"
44.2	15.70	19.31	7.47	1.966	17.92	2.66	"
-	-	31.0	7.50	-	-	-	S.S. $\cdot \frac{5}{2}H_2O$ + S.S. $\cdot 4H_2O$
35.2	25.9	33.1	7.55	1.992	30.4	2.86	S.S. $\cdot 4H_2O$
30.3	30.4	40.3	7.88	1.994	46.3	3.23	"
24.2	36.0	50.0	8.36	1.981	57.2	3.23	"
18.51	41.1	59.9	8.91	1.988	66.7	3.32	"
16.09	43.4	64.5	9.09	1.981	69.0	3.17	"
13.36	46.2	70.0	9.27	1.979	73.2	3.02	"
10.20	49.2	76.4	9.56	1.975	86.5	3.32	"
6.65	51.9	84.0	10.17	1.945	91.4	5.07	"
4.63	53.3	88.6	10.58	1.927	97.2	4.22	"
0.0	56.2	100	11.80	1.873	-	-	$CdBr_2 \cdot 4H_2O$
			Results at 35°				
57.3	0.0	0.0	7.59	1.858	-	-	$CdCl_2 \cdot H_2O$
55.4	2.51	2.96	7.51	1.877	1.54	1.34	S.S. $\cdot H_2O$
52.1	6.73	8.00	7.42	1.816	4.23	1.57	"
47.4	12.44	14.87	7.27	1.951	12.16	1.45	"
44.2	15.92	19.51	7.39	1.964	18.37	1.44	"
39.2	22.0	27.4	7.32	1.979	29.1	1.86	"
33.8	28.1	35.9	7.36	2.018	38.4	1.88	*S.S. $\cdot H_2O$ + S.S. $\cdot 4H_2O$
30.9	30.9	40.2	7.51	2.032	41.9	3.40	S.S. $\cdot 4H_2O$
27.5	34.5	50.2	7.64	2.036	52.5	2.54	"
20.9	41.5	57.2	7.85	2.042	67.1	1.76	"
15.88	46.2	66.2	8.23	2.031	67.4	3.17	"
15.22	46.3	67.2	8.44	2.031	70.4	3.42	"
12.75	48.8	72.1	8.59	2.016	75.0	3.09	"
12.24	48.9	72.9	8.77	2.022	78.5	2.26	"
9.39	51.6	78.7	9.01	2.017	87.0	2.87	"
6.66	54.0	84.5	9.31	2.013	87.4	4.02	"
4.60	55.9	89.1	9.53	2.002	91.4	2.66	"
3.27	57.1	92.2	9.67	1.992	95.4	4.37	"
0.0	59.2	100	10.43	1.966	-	-	$CdBr_2 \cdot 4H_2O$

*(plus anhydrous solid solution(?))

Solution					Solid		
Wt. % $CdCl_2$	Wt. % $CdBr_2$	x	m	Density	x	m	Composition
			Results at 50°				
57.2	0.0	0.0	7.66	1.853	-	-	$CdCl_2 \cdot H_2O$
53.6	4.88	5.77	7.40	1.901	0.26	2.67	S.S. $\cdot H_2O$
48.6	9.64	11.79	7.32	1.936	9.88	2.56	"
46.1	14.25	17.24	7.26	1.968	16.43	2.40	"
38.9	22.4	27.9	7.31	2.004	23.2	2.83	"
36.5	25.2	31.7	7.30	2.029	29.1	2.89	"
30.4	31.0	41.5	7.40	2.048	33.6	3.01	"
-	-	43.0	7.45	-	-	-	S.S. $\cdot H_2O$ + S.S.
27.5	34.7	45.9	7.56	-	47.7	3.14	Solid Solution
27.5	35.0	46.1	7.48	-	48.2	2.83	"
24.8	37.7	50.2	7.61	2.058	52.8	2.48	"
16.24	45.7	65.5	8.23	2.078	70.5	2.75	"
11.84	50.3	74.1	8.42	2.061	78.4	2.74	"
10.68	50.0	76.8	8.68	2.055	83.2	3.60	"
8.98	52.6	79.8	8.83	2.054	94.7	2.74	"
5.67	55.5	86.8	9.18	2.040	88.2	2.59	"
0.0	60.8	0.0	9.74	2.047	-	-	$CdBr_2$
			Results at 75°				
58.0	0.0	0.0	7.36	1.908	-	-	$CdCl_2 \cdot H_2O$
56.9	1.64	1.90	7.28	1.926	0.0	2.12	S.S. $\cdot H_2O$
52.5	7.14	8.42	7.15	1.980	4.15	1.62	"
50.7	9.44	11.13	7.11	1.983	8.74	1.70	"
42.3	19.41	23.6	7.04	2.043	19.02	2.42	"
39.4	22.9	28.2	7.00	2.053	23.2	2.55	"
37.1	25.5	31.7	7.04	2.078	25.0	2.36	"
30.2	33.5	42.8	7.03	2.110	41.7	2.46	"
24.7	39.2	51.7	7.21	2.119	51.2	2.46	S.S. $\cdot H_2O$ + S.S.
22.1	41.5	55.8	7.41	2.128	61.3	2.04	Solid Solution
21.6	41.9	56.7	7.47	2.134	57.8	1.84	"
19.13	44.6	61.1	7.53	2.134	69.0	1.75	"
14.80	48.6	68.9	7.84	2.133	70.7	2.73	"
11.97	51.3	74.3	8.03	2.126	77.2	2.96	"
10.50	52.6	77.1	8.19	2.127	84.1	2.01	"
8.18	53.6	81.7	8.70	2.081	89.5	2.77	"
3.68	58.0	91.4	9.13	2.077	90.4	1.53	"
1.28	60.2	96.9	9.39	2.052	94.7	1.67	"
0.0	61.2	0.0	9.57	2.047	-	-	$CdBr_2$
			Results at 100°				
59.2	0.0	0.0	7.00	1.993	-	-	$CdCl_2 \cdot H_2O$
56.3	3.82	4.37	6.90	2.023	1.54	1.83	S.S. $\cdot H_2O$
47.9	14.72	17.14	6.58	2.095	12.23	1.78	"
40.3	23.4	28.1	6.59	2.151	19.54	1.86	"
34.0	30.9	38.0	6.53	2.185	36.2	1.62	"
28.2	37.3	47.1	6.59	2.217	45.1	1.58	"
24.4	43.1	54.4	6.72	2.214	56.7	2.09	"
-	-	59.0	6.8	-	-	-	S.S. $\cdot H_2O$ + S.S.
18.85	47.0	62.7	6.88	2.237	67.1	1.43	Solid Solution
16.94	48.4	65.8	7.11	2.230	77.6	1.83	"
8.75	54.8	80.9	8.11	2.177	87.2	0.71	"
5.26	57.2	88.0	8.75	2.150	92.9	0.62	"
0.0	61.4	100	9.50	2.110	-	-	$CdBr_2$

Br

SOLUBILITY OF CADMIUM BROMIDE IN WATER

(Benrath, 1941)

Br

t°	Gms. $CdBr_2$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $CdBr_2$ per 100 gms. Sat. Sol.	Solid Phase
-4.4	33.15	$CdBr_2 \cdot 4H_2O$ + Ice	218	70.1	$CdBr_2$
36	60.33	$CdBr_2 \cdot 4H_2O$ + $CdBr_2$	248	72.5	"
185	67.2	$CdBr_2$	269	75.0	"
196	68.0	"	290	77.5	"
210	69.1	"	350	82.9	"
			*567	100.0	"

*Melting point of $CdBr_2$

An X-Ray analysis of the system $CdBr_2 - CdI_2$ was made by Hagg and Linden, 1942.

CADMIUM PYRIDINE-RHODINATE $Cd(CNS)(C_5H_5N)$?

CH

4.58×10^{-3} moles are dissolved in one liter of a saturated solution in water. 3.22×10^{-3} moles are dissolved in one liter of a saturated solution in absolute alcohol (Probably at 20°). Treadwell and Ammann, 1938.

CADMIUM CUPFERRATE $Cd(C_6H_5N(NO)O)_2$

CH

5.46×10^{-3} moles are dissolved in one liter of a saturated solution in water which is 0.01 N with Acetic Acid (Probably at 20°) Treadwell and Ammann, 1938.

CADMIUM ANTHRANILATE $Cd(H_2NC_6H_4COO)_2$

CH

0.0141 moles are dissolved in one liter of a saturated solution in water which is 1.0 N with Acetic Acid (Probably at 20°) Treadwell and Ammann, 1938.

CADMIUM OXYQUINOLATE $Cd(C_9H_6ON)_2 \cdot 2H_2O$

CH

0.0108 moles are dissolved in one liter of a saturated solution in water which is 1.0 N with Acetic Acid (Probably at 20°) Treadwell and Ammann, 1938.

CADMIUM FERRICYANIDE $Cd_3(Fe(CN)_6)_2 \cdot pH_2O$

CN

SOLUBILITY OF CADMIUM FERRICYANIDE IN SALT SOLUTIONS

(King, 1949)

Each solution contained 2.96 M Na^+, 0.04 M H^+, and (3.00 - Cl^-) M ClO_4^-. The data were used in the study of complex Cadmium Chloride Ions.

CN

Total Cl^- Moles per Liter	Moles $Cd_3(Fe(CN)_6)_2$ per liter x 10^5			Total Cl^- Moles per Liter	Moles $Cd_3(Fe(CN)_6)_2$ per liter x 10^5		
	0°	25°	*47.5°		0°	25°	*47.5°
0.000	3.9	6.7	9.7	0.080	9.6	17.6	26.8
.018	-	-	13.8	.154	14.8[a]	-	-
.020	5.2	8.7	-	.160	15.5	27.9	40.2
.036	-	-	16.3	.280	25.9	46.9	75
.040	6.7	10.8	-	.480	49.5	85.9	124.1
				.800	84	182	251

*In all 47.5° experiments H^+ = 0.02 M a(H^+= 0.15 M Na^+= 2.83 M)
Na^+ = 2.98 M

CNS **CADMIUM Mercuri THIOCYANATE** $Cd[Hg(CNS)_4]$

Straumanis and Stahl, 1943 studied the binary systems $Cd[Hg(CNS)_4]$ + $Co[Hg(CNS)_4]$ and $Cd[Hg(CNS)_4]$ + $Zn[Hg(CNS)_4]$. In 1944 the authors studied the ternary system $Cd[Hg(CNS)_4]$ + $Co[Hg(CNS)_4]$ + $Zn[Hg(CNS)_4]$.

C_2O_4 **CADMIUM OXALATE** CdC_2O_4

SOLUBILITY OF CADMIUM OXALATE IN SALT SOLUTIONS AT 25°
(Vosburgh and Beckman, 1940)

In $KClO_3$ Solutions Moles per 1000 gms. H_2O		In $Cd(ClO_4)_2$ Solutions Moles per 1000 gms. H_2O		In K_2SO_4 Solutions Moles per 1000 gms. H_2O	
$KClO_3$	CdC_2O_4	$Cd(ClO_4)_2$	CdC_2O_4	K_2SO_4	CdC_2O_4
0.0	0.000289	0.005	0.000173	0.005	0.000390
0.005	.000316	.010	.000191	.010	.000463
.010	.000341	.020	.000234	.020	.000564
.020	.000365	.030	.000272	.040	.000719
.040	.000413	.040	.000323		
.080	.000475	.050	.000353		

SOLUBILITY OF CADMIUM OXALATE IN SALT SOLUTIONS AT 25°
(Pesce and Lago, 1944)

In Sodium Sulfate Solutions Moles per 1000 gms. H_2O		In Magnesium Sulfate Solutions Moles per 1000 gms. H_2O	
Na_2SO_4	CdC_2O_4	$MgSO_4$	CdC_2O_4
0.0	0.000309 (± 0.000007)	0.226	0.00659
0.078	.000947	.472	.01175
.156	.001294	.681	.01571
.237	.001623	.901	.01992
.313	.001915	1.132	.02429
.393	.002182	1.585	.03089
.469	.002349	2.321	.03508
.688	.002761		

CADMIUM CHLORIDE $CdCl_2$ Cl

SOLUBILITY OF CADMIUM CHLORIDE IN WATER
(Benrath, 1941)

t°	Gms. $CdCl_2$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $CdCl_2$ per 100 gms. Sat. Sol.	Solid Phase
-11.5	43.4	$CdCl_2 \cdot 4H_2O$ + Ice	204	72	$CdCl_2$
- 5	46.2	$CdCl_2 \cdot 4H_2O + CdCl_2 \cdot 2.5H_2O$	208	73	"
34	57.4	$CdCl_2 \cdot 2.5H_2O + CdCl_2 \cdot H_2O$	214	74	"
124	61.0	$CdCl_2 \cdot H_2O$	218	75.0	"
154	63.5	"	233	77.5	"
160	64.5	"	252	79.0	"
166	66.0	"	303	82.5	"
169	67.0	"	342	85.5	"
173	68.0	"	*564	100.0	"
174	69.0	$CdCl_2 \cdot H_2O + CdCl_2$			
188	70	$CdCl_2$	*Melting point of $CdCl_2$		
198	71	"			

EQUILIBRIUM IN THE SYSTEM $CdCl_2$ - HCl - H_2O AT 25°
(Kuznetsov and Kozhukhovski, 1936a)

Gms. $CdCl_2$ per 1000 gms. H_2O.	Gms. HCl per 1000 gms. H_2O	Solid Phase
1194	0.0	$CdCl_2 \cdot 2\frac{1}{2}H_2O$
1094	59.90	"
1065	97.29	"
1086	127.9	$CdCl_2 \cdot H_2O$
1080	125.0	"
1061	150.6	"
1099	202.0	"
1118	225.8	"
1184	244 9	"
1292	280.7	$2CdCl_2 \cdot H_2O + 2CdCl_2 \cdot HCl \cdot 4H_2O$
1217	328.0	$2CdCl_2 \cdot HCl \cdot 4H_2O$
1169	363.7	"
1149	388.1	"
1135	425.9	"
1055	491.3	"
938.6	531.5	$CdCl_2 \cdot HCl \cdot 3H_2O$
838.8	568.1	"
785.2	640.7	"

EQUILIBRIUM IN THE SYSTEM $CdCl_2$ - NaCl - H_2O
(Hering, 1945, 1946)

The author studied the entire system from the freezing points to 100°, and presents diagrams which show the solid phases in equilibrium with saturated solutions of any composition and temperature. There are five double salts in the system:

$CdCl_2 \cdot NaCl \cdot 2H_2O$ (above 37.7°) (Always congruently soluble)
$CdCl_2 \cdot NaCl \cdot 3H_2O$ (All temperatures) (Congruently soluble above 10.5°)
$4CdCl_2 \cdot 8NaCl \cdot 14H_2O$ (Below 44.0°) (Always congruently soluble)
$CdCl_2 \cdot 8NaCl \cdot 16H_2O$ (Below 19.2°) (Always incongruently soluble)
"Y" (Composition undetermined) (Below about 3.8°)

The results agree very well with those of Bassett, Henshall, and Sergeant at 25°, but disagree with the data of Sudhaus (both Vol. I, p. 362), who found only one double salt from 19° to 55°.

The author also includes a summary of the double salts of Cadmium and Mercury halides in binary and ternary systems with alkali metals.

Cl

Gms. $CdCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Density	Solid Phase
		Results at 0°	
46.45	2.5	-	$CdCl_2 \cdot 2\frac{1}{2}H_2O$ + 4:3:14
42.3	3.6	1.587	4:3:14
38.7	4.4	1.533	"
29.0	7.75	1.409	"
25.4	8.65	1.357	"
19.7	13.0	-	"
17.8	15.2	-	4:3:14 + 1:2:3
6.8	20.5	1.236	1:2:3
5.55	21.35	-	"
(M) 3.15	24.0	-	"
(M) 4.95	21.95	-	1:2:3 + 1:8:16
5.05	21.9	-	"Y" + 1:8:16
4.45	22.1	-	"
3.15	22.55	-	1:8:16
1.1	23.65	-	"
0.75	24.0	-	"
(M) 2.1	25.9	-	1:2:3 + NaCl
0.07	26.35	-	1:8:16 + NaCl + $NaCl \cdot 2H_2O$
		Results at 19.3°	
51.6	3.6	1.770	$CdCl \cdot 2\frac{1}{2}H_2O$ + 4:3:13
50.2	4.1	1.745	4:3:13
41.0	7.3	1.600	"
36.3	9.3	1.537	"
28.4	14.5	1.464	4:3:13 + 1:2:3
4.3	25.8	1.243	1:2:3 + NaCl
		Results at 39°	
54.2	6.2	1.860	$CdCl_2 \cdot H_2O$ + 4:3:13
50.4	7.8	1.792	4:3:13
46.5	9.6	1.729	"
42.6	11.7	1.678	"
39.7	13.3	1.639	1:1:2 + 1:2:3
37.5	13.8	1.600	1:2:3
8.5	25.45	1.278	1:2:3 + NaCl
		Results at 60°	
53.4	9.0	1.866	$CdCl_2 \cdot H_2O$ + 1:1:2
49.9	10.6	1.803	1:1:2
47.4	11.6	1.764	"
42.6	14.0	1.686	"
41.1	14.7	1.662	1:1:2 + 1:2:3
36.5	16.3	1.588	1:2:3
15.1	24.8	1.338	1:2:3 + NaCl

Gms. $CdCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. sol.	Density	Solid Phase
57.8	2.6	-	$CdCl_2 \cdot H_2O$
56.0	5.9	-	"
54.9	11.2	-	"
54.7	12.6	-	$CdCl_2 \cdot H_2O$ + 1:1:2
53.6	13.0	-	1:1:2
48.6	15.6	-	"
47.6	16.4	-	1:1:2 + 1:2:3
39.1	19.7	-	1:2:3
28.9	24.0	-	1:2:3 + NaCl
27.0	24.3	-	NaCl
18.0	26.3	-	"

(M) Indicates Metastable

* The exact composition of the double salt "Y" was not determined, but the ratio of NaCl:$CdCl_2$ in it was greater than 6.5:1. The equilibrium temperature for the reaction Y $\rightleftharpoons$ 1:2:3 + 1:8:16 + Solution was not determined exactly and is thought to be 3.8°, but may be as low as -0.6°. At temperatures below 0°, the compound has a well defined region of stability.

INVARIANT SOLUTIONS IN THE SYSTEM $CdCl_2$ - NaCl - H_2O

(Hering)

t°	Gms. $CdCl_2$ per 100 gms. Sat. Sol.	Gms. NaCl per 100 gms. Sat. Sol.	Solid Phase
44.0	53.8	7.1	$CdCl_2 \cdot H_2O$ + 1:1:2 + 4:3:14
29.8	54.7	4.4	$CdCl_2 \cdot H_2O$ + $CdCl_2 \cdot 2\frac{1}{2}H_2O$ + 4:3:14
-7.1	44.55	2.2	$CdCl_2 \cdot 2\frac{1}{2}H_2O$ + $CdCl_2 \cdot 4H_2O$ + 4:3:14
-11.4	41.85	2.25	$CdCl_2 \cdot 4H_2O$ + 4:3:14 + Ice
37.7	39.6	13.2	4:3:14 + 1:1:2 + 1:2:3
-12.2	11.45	15.6	4:3:14 + 1:2:3 + Ice
-16.7	4.85	19.1	1:2:3 + 1:8:16 + Ice
-17.0	2.0	19.85	"Y" + 1:8:16 + Ice
-21.1	0.03	23.2	NaCl · $2H_2O$ + 1:8:16 + Ice

CADMIUM Sodium CHLORIDE $CdCl_2 \cdot NaCl \cdot 2H_2O$

Cl

SOLUBILITY IN WATER

(Hering, 1945, 1946)

t°	Gms. $CdCl_2 \cdot NaCl$ per 100 gms. Sat. Sol.
38.3	53.2
60.0	56.7
100.0	64.3

CADMIUM Disodium CHLORIDE

Cl

SOLUBILITY IN WATER

(Hering, 1945, 1946)

t°	Gms. $CdCl_2 \cdot 2NaCl$ per 100 gms. Sat. Sol.	t°	Gms. $CdCl_2 \cdot 2NaCl$ per 100 gms. Sat. Sol.	t°	Gms. $CdCl_2 \cdot 2NaCl$ per 100 gms. Sat. Sol.
13.0	38.8	40.0	44.2	70.0	49.8
19.3	40.1	50.0	46.1	80.0	51.7
24.0	41.2	60.0	47.9	90.0	53.7
				100.0	55.9

Cl Tetra CADMIUM Tri Sodium CHLORIDE $4CdCl_2 \cdot 3NaCl \cdot 14H_2O$

SOLUBILITY IN WATER
(Hering, 1945, 1946)

t°	Gms. $4CdCl_2 \cdot 3NaCl$ per 100 gms. Sat. Sol.
19.3	46.0
39.0	55.1
40.3	55.5

Cl CADMIUM Choline CHLORIDE $(CH_3)_2NClC_2H_4OH \cdot CdCl_2$

0.01 gms. are dissolved in 100 ml. of solution in water at room temperature. (Seaman, Hugonet, and Leibmann, 1949).

Melting points have been determined in the following systems:

$CdCl_2 + InCl_3$	(Vovkogon and Fialkov, 1945)
$CdCl_2 + PbCl_2$	(Tarasova, 1947)
$CdCl_2 + KCl + PbCl_2$	" "
$CdCl_2 + PbCl_2 + TlCl$	(Bergman and Tapchanyan, 1941)
$CdCl_2 + CsCl$	(Dergonov, 1949)
$CdCl_2 + NaCl$	" "
$CdCl_2 + KCl$	" "
$CdCl_2 + RbCl$	" "
$CdCl_2 + LiCl$	" "
$CdCl_2 + RbCl + CsCl$	" "

I CADMIUM IODIDE CdI_2

SOLUBILITY OF CADMIUM IODIDE IN WATER AND DEUTERIUM OXIDE
(Eddy and Menzies, 1940)

See Note page 67. The authors determined the solubility of Cadmium Iodide in Water and Deuterium Oxide at several temperatures and present rounded values read from a plot of their data. The results in Water agree fairly well with those previously reported (Vol. I, p. 366), and the authors' original four points are given below. In Deuterium Oxide, eleven evenly spaced determinations were made, and the rounded values at integral temperatures listed by the authors are tabulated below. The solid phase was CdI_2 throughout.

Results in H_2O		Results in D_2O (99.4%)							
t°	Gms. CdI_2 per 100 gms. H_2O	t°	Gms. CdI_2 per 100 gms. D_2O	t°	Gms. CdI_2 per 100 gms. D_2O	t°	Gms. CdI_2 per 100 gms. D_2O	t°	Gms. CdI_2 per 100 gms. D_2O
76.9	109.1	0	49.4	40	62.6	80	81.1	120	106.8
99.1	125.6	5	50.7	45	64.6	85	83.7	125	110.7
131.2	150.9	10	52.4	50	66.6	90	86.7	130	114.7
155.1	177.6	15	54.0	55	68.9	95	89.6	135	118.9
		20	55.7	60	71.2	100	92.6	140	123.6
		25	57.3	65	73.5	105	95.9	145	128.2
		30	59.0	70	75.8	110	99.2	150	133.1
		35	60.6	75	78.4	115	102.8		

Experiments by Hedvall, Wallgren, and Mansson (1940) showed that samples of CdI_2 which were irradiated with a Mercury Lamp showed an increase in solubility over the solubility in darkness or after radiation with white light. A mixture of 92 parts by volume of Benzine (Free of unsaturated hydrocarbons) + 8 parts Alcohol (99.5% Ethanol, 0.5% H_2O) was used as solvent. A typical experiment using 6.590 grams CdI_2 showed 0.00355 gms. dissolved before irradiation, and 0.00400 gms. after irradiation.

EQUILIBRIUM IN THE SYSTEM CADMIUM IODIDE - MERCURIC IODIDE - WATER I

(Hietanen and Sillen, 1947)

Solution		Solid	
Wt. % CdI_2	Wt. % HgI_2	Wt. % CdI_2	Wt. % HgI_2
	Results at 50°		
48.4	0.0	100.0	0.0
44.8	3.4	95.1	4.9
43.5	3.5	70.1	29.9
43.5	3.3	47.6	52.4
43.2	4.1	49.7	50.3
38.0	5.5	26.1	73.9
34.1	6.2	16.4	83.6
32.5	6.6	10.7	89.3
28.0	6.7	10.5	89.5
24.4	6.6	4.8	95.2
19.9	6.6	3.9	96.1
13.7	5.8	2.4	97.6
8.4	3.7	1.5	98.5
	Results at 75°		
49.4	3.7	99.3	0.7
49.8	3.7	79.4	20.6
49.6	3.3	65.0	35.0
49.0	3.3	49.1	50.9
44.3	4.9	33.0	67.0
38.9	6.8	21.9	78.1
33.0	7.6	11.2	88.8
24.0	7.6	3.6	96.4
12.8	5.5	0.7	99.3
6.3	3.5	1.0	99.0

Solution		Solid	
Wt. % CdI_2	Wt. % HgI_2	Wt. % CdI_2	Wt. % HgI_2
	Results at 100°		
55.0	0.0	100.0	0.0
53.3	4.3	78.1	21.9
53.2	3.7	92.8	7.2
53.1	3.9	70.3	29.7
52.5	4.2	68.6	31.4
51.3	4.7	50.6	49.4
49.8	5.4	58.2	41.8
46.0	7.0	33.7	66.3
46.0	7.0	35.2	64.8
40.6	8.3	17.8	52.2
40.3	8.2	21.0	79.0
35.3	9.2	0.0	100.0
34.0	9.5	11.1	88.9
26.3	9.3	17.8	82.2
22.5	9.0	2.6	97.4
12.6	7.0	0.4	99.6
10.3	5.8	42.6	57.4
6.5	3.6	0.0	100.0
0.0	0.2	0.0	100.0

The invariant solutions have the following compositions:

50°	43.8% CdI_2	3.6% HgI_2
75°	49.5% "	3.5% "
100°	53.0% "	4.0% "

The limit of the solubility of CdI_2 in HgI_2 was found to be:

50°	40 ± 8% CdI_2	
75°	45 ± 8% "	(in the systems $CdI_2 + HgI_2 + H_2O$)
100°	55 ± 8% "	

IO CADMIUM IODATE $Cd(IO_3)_2$

SOLUBILITY OF CADMIUM IODATE IN SALT SOLUTIONS
(Oelke and Wagner, 1939)

Estimated from the curves given by the authors. No temperature given.

Moles KCl per 1000 gms. H_2O	Moles $Cd(IO_3)_2$ per 1000 gms. H_2O	Moles $MgSO_4$ per 1000 gms. H_2O	Moles $Cd(IO_3)_2$ per 1000 gms. H_2O
0.02	0.0022	0.02	0.0026
.06	.0031	.06	.0033
.5	.009	.5	.006
1.0	.016	1.0	.0075
2.5	.046	2.5	.009

NC CADMIUM NITRATE $Ca(NO_3)_2$

Freezing points in the systems $Cd(NO_3)_2 + NH_4NO_3$ and $Cd(NO_3)_2 + NH_4NO_3 + NaNO_3$ are given by Campbell and Campbell, 1947.

C CADMIUM OXIDE CdO

The system CdO - ZnO at 900° was studied by Rigamonti (1946).

CH CADMIUM HYDROXIDE $Cd(OH)_2$

Oka, 1940 found the solubility to be 8.5×10^{-6} moles per liter by potentiometric titration. Moeller and Rhymer, 1942 found the solubility product to be 3.2×10^{-14} by similar means.

SOLUBILITY OF CADMIUM HYDROXIDE IN SODIUM HYDROXIDE SOLUTIONS
(Scholder and Staufenbiel, 1941)

The authors determined the composition of the solid phase in equilibrium with solutions of Sodium Hydroxide at the boiling point, 100°, and 80°. Silver vessels were used and the solution was filtered through a sintered glass plate in an atmosphere free of CO_2. The solid was then dried on porous clay plates.

Results at the boiling points (120° to 140°)

Solution		Solid Phase	Solution		Solid Phase
Normality of NaOH	Gms. NaOH per 100 gms. Sat. Sol.		Normality of NaOH	Gms. NaOH per 100 gms. Sat. Sol.	
3.0	10.4	$Cd(OH)_2$	16.1	43.8	$Na_2Cd(OH)_4$
6.0	20.0	"	16.6	45.0	"
9.0	27.5	"	17.1	46.0	"
12.5	36.0	"	17.3	46.3	"
13.8	39.2	"	17.6	47.0	"
14.5	40.5	"	18.0	48.0	"
15.0	41.5	$Na_2Cd(OH)_4$	18.4	48.8	"
15.6	42.8	"	19.0	50.0	"

Results at 100°

Solution			Solid Phase
Normality of NaOH	Gms. NaOH per 100 gms. Sat. Sol.	Mg. CdO per 100 gms. Sat. Sol.	
6.8	22.7	18.4	$Cd(OH)_2$
9.6	30.0	37.7	"
12.1	36.3	65.6	"
13.5	39.4	92.5	"
13.9	40.4	100.7	"
14.8	42.3	89.5	$Na_2Cd(OH)_2$
16.6	46.3	51.5	"
18.4	50.0	26.5	"

Results at 80°

At 80° the composition of the solid phases varied with NaOH concentration and were not as clear cut as in the case at the boiling points and 100°.

Final Normality of NaOH N	Approximate Ratios in Solid Cd : Na : H_2O	Probable Solid Phase
12.1 - 14.7	1 : 0.3 : 2.8	$Cd(OH)_2$
14.7 - 15.4	1 : 2.1 : 3.5	$Na_2Cd(OH)_4$
15.5 - 18.4	1 : 2.6 : 4.3	$Na_2Cd(OH)_4 \cdot \frac{1}{2}NaOH \cdot 1\text{-}1\frac{1}{2}H_2O$
18.8 - 22.0	1 : 3.3 : 5.3	$Na_3[Cd(OH)_5H_2O] \cdot H_2O$

EQUILIBRIUM IN THE SYSTEM CADMIUM OXIDE - CADMIUM SULFATE - WATER AT 18°

(Gromov, 1948)

$CdSO_4$ Wt. %	Cd Gms. per Liter	Density	pH	Solid Phase
43.4	368.6	1.580	5.65	$3CdO \cdot CdSO_4 \cdot xH_2O + CdSO_4 \cdot 8/3H_2O$
25.6	178.2	1.292	6.31	$3CdO \cdot CdSO_4 \cdot xH_2O$
16.9	109.3	1.176	6.70	"
10.9	64.8	1.097	7.00	"
6.88	38.7	1.042	7.19	"
2.35	12.8	1.010	7.38	"
2.17	11.8	1.009	7.38	"
0.00	0.0	1.000	8.00	$Cd(OH)_2$

In contrast to the above results. Bye (1946) presents evidence that the compound $Cd(OH)_2 \cdot CdSO_4$ exists in equilibrium with solutions containing 0.3% to 43.6% $CdSO_4$, and that the compound $3Cd(OH)_2 \cdot CdSO_4$ exists only in contact with solutions containing 0.1% to 0.2% $CdSO_4$.

S CADMIUM SULFIDE CdS

Kapustinsky (1940) calculated the solubility product of CdS from free energy data and obtained the value 1.2×10^{-28} which agrees well with previous values.

The calculated solubility in acid solutions are:

pH	3	5	7	9	11
Gm. mols. CdS per liter	1.0×10^{-6}	1.1×10^{-8}	1.5×10^{-10}	1.1×10^{-11}	1.1×10^{-12}

– The solid solutions in the system CdS – MnS – ZnS were studied by Kroger (1940).

SO CADMIUM SULFATE $CdSO_4$

SOLUBILITY IN H_2O AND D_2O MIXTURES
(Brickwedde, 1946)

The author determined the solubility of $CdSO_4$ in five mixtures of H_2O+ D_2O ranging from 0.02% to 99.5% D_2O and at temperatures from -1° to 72°. The results were plotted, and the author presents the table below which lists lists values at temperatures and D_2O concentrations found mainly by interpolation. The transition $CdSO_4 \cdot 8/3 H_2O \rightleftharpoons CdSO_4 \cdot H_2O$ + Aq. occurred at 43.6°, and $CdSO_4 \cdot 8/3 D_2O \rightleftharpoons CdSO_4 \cdot D_2O$ + aq. at 45.4°. The results agree rather well with those previously reported (Vol. I, p. 377), and a composite graph is drawn. Many previous authors did not realize that their data were metastable because of the long time required to attain equilibrium. The results below are in terms of moles $CdSO_4$ dissolved per 100 moles of solvent:

Solid Phase	t°	Mole % D_2O in Solvent					
		0.02*	6.0	50.0	80.0	99.5	100.0
$CdSO_4 \cdot 8/3 Aq.$	0	6.546	6.511	6.285	6.131	6.029	6.026
"	5	6.555	6.520	6.294	6.138	6.036	6.033
"	10	6.566	6.531	6.305	6.147	6.045	6.042
"	15	6.580	6.545	6.319	6.159	6.058	6.055
"	20	6.600	6.565	6.339	6.177	6.076	6.073
"	23.5	6.619	6.584	6.358	6.194	6.093	6.090
"	25	6.627	6.592	6.366	6.202	6.100	6.097
"	30	6.663	6.627	6.402	6.236	6.133	6.130
"	35	6.710	6.674	6.449	6.281	6.177	6.174
"	40	6.773	6.737	6.512	6.342	6.235	6.232
"	42	6.803	6.769	6.542	6.371	6.263	6.260
"	45	(M)6.857	(M)6.823	6.594	6.423	6.314	6.311
"	50	(M)6.966	(M)6.932	(M)6.696	(M) 6.530	(M)6.418	(M) 6.415
$CdSO_4 \cdot \frac{8}{3} Aq. + CdSO_4 \cdot 1Aq.$	43.6	6.833	–	–	–	–	–
"	43.9	–	6.803	–	–	–	–
"	45.0	–	–	6.592	–	–	–
"	45.3	–	–	–	6.430	–	–
"	45.4	–	–	–	–	6.317	6.314
$CdSO_4 \cdot Aq.$	45	6.797	6.775	6.591	M6.440	M6.330	M6.326
"	50	6.659	6.638	6.448	6.299	6.185	6.181
"	55	6.522	6.501	6.304	6.159	6.041	6.037
"	60	6.385	6.363	6.159	6.019	5.897	5.893
"	65	6.24	–	–	–	–	–
"	70	6.11	–	–	–	–	–
"	72	6.05	–	–	–	–	–

*0.02% D_2O = Ordinary Water (M) = Metastable

Denk, 1949 studied the precipitation of Cadmium Sulfate upon addition of Sodium Hydroxide and Sodium Carbonate at various temperatures, and concluded that 3 basic salts exist: $CdSO_4 \cdot 3Cd(OH)_2$, $CdSO_4 \cdot 2Cd(OH)_2$, $CdSO_4 \cdot Cd(OH)_2$.

EQUILIBRIUM IN THE SYSTEM CADMIUM SULFATE - MAGNESIUM SULFATE - WATER AT 25° AND 40°

(Vosburg, Dibeler, Parks, and Miller, 1940)

The authors determined dE/dT for a cell saturated with $MgSO_4 \cdot 7H_2O$ and $CdSO_4 \cdot 8/3H_2O$ and found an abrupt change about 30°. Equimolecular quantities of the two salts were equilibriated with water at 40°, and the cooling curve was determined. Heat was liberated at 30.2° and so the transition temperature for the double salt in contact with an equimolecular mixture of $MgSO_4$ and $CdSO_4$ was 30.2°. Many determinations were made at 25° (± 0.1°) to try to detect the field of stability for the double salt, but none was found. At 40° (± 0.2°) the compound is congruently soluble. SO

Results at 25°			Results at 40°		
Gms. $CdSO_4$ per 100 gms.	Gms. $MgSO_4$ per 100 gms.	Solid Phase	Gms. $CdSO_4$ per 100 gms.	Gms. $MgSO_4$ per 100 gms.	Solid Phase
6.5	23.8	$MgSO_4 \cdot 7H_2O$	2.6	29.6	$MgSO_4 \cdot 7H_2O$
12.5	20.9	"	5.0	28.8	"
17.2	18.3	"	7.6	27.8	"
17.4	18.9	"	9.2	28.0	$MgSO_4 \cdot 7H_2O$ + 1:1:14
21.7	17.0	"	9.6	27.8	"
25.5	15.2	$MgSO_4 \cdot 7H_2O$ + $CdSO_4 \cdot \frac{8}{3}H_2O$	10.2	27.5	"
25.7	14.9	"	9.6	28.3	"
25.8	15.4	"	12.1	24.4	1:1:14
26.0	15.0	"	17.2	20.0	"
26.1	15.0	"	14.5	22.4	"
26.2	15.3	"	20.0	17.6	"
26.2	15.1	"	20.9	17.1	"
26.4	15.0	"	24.2	14.3	"
26.4	15.2	"	28.2	12.2	"
26.9	14.9	"	33.5	10.4	"
27.0	13.9	$CdSO_4 \cdot \frac{8}{3}H_2O$	38.8	9.2	"
29.1	12.5	"	39.6	9.2	1:1:4 + $CdSO_4 \cdot \frac{8}{3}H_2O$
30.5	11.2	"	40.1	8.8	"
30.5	11.0	"	40.9	7.7	$CdSO_4 \cdot \frac{8}{3}H_2O$
34.0	8.0	"	42.7	4.5	"
38.6	4.3	"			

CADMIUM SELENATE $CdSeO_4$ SeO

SOLUBILITY IN WATER

(Klein, 1940)

The author found that evaporation of a saturated solution led to the precipitation of the dihydrate which, however, was not the stable phase. Prolonged agitation showed that the monohydrate was the stable phase at all temperatures from the eutectic to 100°. The composition of the solids in contact with the saturated solutions were determined at several temperatures, and the existence of the monohydrate was further confirmed by following the loss in weight of the dihydrate upon heating.

	t°	Density	Grams $CdSeO_4$ per 100 gms. Sat. Sol.	Grams $CdSeO_4$ per 100 gms. Water	Solid Phase
	-3.2	-	28.24	39.35	Ice
	-5.8	-	35.85	55.88	"
SeO	-7.8	1.5520	39.54	65.39	"
	(M)-11	-	43.47	76.89	Ice + $CdSeO_4 \cdot 2H_2O$
	-10.8	-	-	-	Ice + $CdSeO_4 \cdot H_2O$
	(M) 0	1.6241	42.76	74.70	$CdSeO_4 \cdot 2H_2O$
	(M) 10	1.5950	42.16	72.89	"
	(M) 20.2	1.5950	40.63	68.43	"
	(M) 40	1.5015	37.80	60.77	"
	(M) 54.2	1.4520	35.59	55.25	"
	(M) 60.2	1.4306	34.37	52.36	"
	(M) 70	-	32.48	48.0	"
	-9.5	-	43.28	76.30	"
	-4.8	1.6195	42.55	74.06	"
	0	1.6048	42.01	72.44	"
	10	1.5725	40.53	68.44	"
	15	1.5555	39.52	65.40	"
	17	1.5490	39.25	65.40	"
	21.6	1.5337	38.89	63.64	"
	26	1.5155	37.98	61.23	"
	30	1.5012	37.07	58.90	"
	35.2	1.4823	36.48	57.43	"
	45	1.4412	34.44	52.53	"
	48	1.4284	33.98	51.46	"
	51.4	1.4074	32.87	48.96	"
	56	1.3886	31.66	46.32	"
	60	1.3664	30.65	44.20	"
	62.4	1.3557	29.98	42.81	"
	70	1.3158	27.93	38.75	"
	80	1.2559	24.51	32.47	"
	90	1.2035	21.45	27.16	"
	98.5	-	18.04	22.01	"

(M) = Metastable

NO **CERROUS NITRATE** $Ce(NO_3)_3$

DISTRIBUTION OF CERROUS NITRATE BETWEEN WATER AND n-HEXYL ALCOHOL AT 25°
(Templeton, 1949)

Gms. CeO_2 per 100 gms. Sat. Sol.		Gms. CeO_2 per 100 gms. Sat. Sol.	
Aqueous Phase	Alcohol Phase	Aqueous Phase	Alcohol Phase
30.3	2.87	26.2	0.85
29.57	2.34	24.47	.57
28.5	1.70	22.83	.34
27.57	1.28	21.5	.26

NO **CERRIUM (ic) NITRATE** $Ce(NO_3)_4$

10 ml. of a saturated solution of cerrium nitrate in ether contain 13.9 mg. CeO_2. (Wells, 1930).

OH **CERIUM HYDROXIDE** $Ce(OH)_3$

Oka, 1940 found the solubility to be 4.0×10^{-6} moles per liter by potentiometric titration.

PO

CERRIC PHOSPHATE $Ce_2(PO_4)_3$
CERRIC PYROPHOSPHATE CeP_2O_7

Data for the solubilities of these salts is found on p. 567 .

WO

CERIUM TUNGSTATE $Ce_2(WO_4)_3$

SOLUBILITY OF CERIUM TUNGSTATE IN WATER
(Vickery, 1949)

t°	Unignited	Ignited
20	0.014 gms./100 ml.	0.001 gms./100 ml.
100	0.020 "	.001 "

Cl

CHLORINE Cl_2

SOLUBILITY IN WATER
(Whitney and Vivian, 1941)

The authors passed various mixtures of Chlorine + Nitrogen through Water and analyzed both the gas phase and the saturated solution.

10°		15°		20°		25°	
Partial Pressure Cl_2 Atm.	Gms. Cl_2 per 100 gms. H_2O	Partial Pressure Cl_2 Atm.	Gms. Cl_2 per 100 gms. H_2O	Partial Pressure Cl_2 Atm.	Gms. Cl_2 per 100 gms. H_2O	Partial Pressure Cl_2 Atm.	Gms. Cl_2 per 100 gms. H_2O
0.061	0.124	0.0581	0.111	0.0665	0.112	0.0621	0.104
.0660	.131	.0611	.115	.1195	.160	.0655	.106
.155	.228	.140	.195	.260	.263	.104	.139
.157	.237	.145	.201	.487	.415	.109	.143
.292	.368	.291	.330	.490	.422	.174	.189
.293	.366	.297	.330	.965	.725	.270	.246
.498	.541	.488	.477			.551	.391
.498	.555	.490	.480			.589	.418
		.951	.825			.961	.628

From these data, the hydrolysis constants were calculated.

The above data have been put into a nomograph by Davis (1941b)

Melting points in the systems of Cl_2 with HCl, CH_3Cl, and CH_2Cl_2 were determined by Wheat and Browne (1940). Cl_2 forms two compounds with HCl: HCl_3 and H_2Cl_4.

SOLUBILITY OF CHLORINE IN HYDROCHLORIC ACID SOLUTIONS
(Mellor, 1901)

The gas was shaken with the liquid, and a 10 ml. portion was removed. The Chlorine was determined by the addition of excess Potassium Iodide Solution, and the titration of the liberated Iodine with Thiosulfate Solution.

α = cc of Cl_2 (measured at 0°, 760 mm pressure) dissolved in 1 ml. of saturated solution.

λ = cc of Cl_2 (measured at 21°, 760 mm pressure) dissolved in 1ml. of saturated solution.

Gms. HCl per 1000 cc	t°	Gms. Cl_2 per 1000 cc	α	λ
0.0	21.0	7.23	2.1167	2.2799
3.134	21.0	5.30	1.5496	1.6698
6.248	20.0	4.94	1.4483	1.5607
9.402	21.0	4.76	1.3942	1.5013
12.540	21.0	4.85	1.4200	1.5292
15.670	21.0	5.10	1.4933	1.6092
31.340	21.0	5.81	1.6736	1.8033
62.680	20.0	6.38	1.8682	2.0131
94.020	20.5	7.19	2.1044	2.2677
125.360	20.5	7.76	2.2711	2.4473
156.700	20.2	8.58	2.5095	2.7043
188.040	20.2	9.23	2.7020	2.9117
219.380	21.0	9.93	2.9243	3.1312
250.720	21.0	10.68	3.1277	3.3677
282.060	21.0	11.87	3.3278	3.5859
313.401	21.0	12.03	3.5492	3.8224

O CHLORINE MONOXIDE Cl_2O

THE SYSTEM CHLORINE MONOXIDE - WATER

(Secoy and Cady, 1940)

The system is characterized by a liquid immiscibility gap, but the work was not attempted above 270° (K°) because of the decomposition and high vapor pressure at higher temperatures. The temperatures were measured with a copper - constantan thermocouple, and are reported in Kelvin degrees.

Temp. °K	Mole % Cl_2O	Solid Phase
267.2	2.7	Ice
264.4	3.9	"
259.4	5.9	"
253.5	7.9	"
251.0	8.4	"
245.1	10.0	"
242.5	10.6	"
233.5	11.7	Ice + $HOCl \cdot 2H_2O$
234.2	11.9	$HOCl \cdot 2H_2O$
234.5	12.0	"
235.3	12.5	"
235.8	13.1	"
236.3	13.7	"
236.6	14.4	"
236.8	15.1	"
236.9	15.4	"
237.0	16.1	"
237.1	16.6	"
237.1	17.5	"
237.0	18.7	"
236.9	19.5	"
236.8	20.7	$HOCl \cdot 2H_2O$ (+ 2 liquids)
152.6	100.0	Cl_2O

Solubility of Cl_2O in H_2O

Temp. °K	Mole % Cl_2O
263.8	22.9
259.9	22.1
257.3	21.7
251.1	20.6
247.4	20.1
246.4	20.0
244.2	20.3
241.2	20.4
240.0	20.5
238.4	20.6
236.8	20.7

Solubility of H_2O in Cl_2O

Temp. °K	Mole % H_2O
270.0	3.4
236.8	2.9
194.6	1.8

SOLUBILITY IN WATER
(Secoy and Cady, 1941)

The authors calculated the heat of solution at each temperature and found that it nearly doubled over a 13° range of temperature. Because this seems unlikely, they regard their data as only tentative. The assumption was made that no HOCl or Hydrates of Cl_2O existed in the vapor phase. The data are in terms of gms. Cl_2O per 100 gms. H_2O: O

Pressure Cl_2O	Temperature		
mm	0°	10°	20°
1	7.6	5.2	3.5
5	16.7	12.3	8.0
10	23.7	17.4	11.1
20	33.6	24.2	15.4
30	40.7	29.2	18.7
40	46.9	33.0	21.3
50	52.4	36.2	23.7
60	56.7	39.0	25.8
70	60.2	41.4	27.7
75	61.6	42.5	28.6

A nomograph has been prepared from the above results by Davis (1942).

COBALT Co

Co

The systems Co + S, Co + Bi + S, and Co + Sb + S were studied by Schenck and von der Forst (1942).

COBALT ACETATE $Co(C_2H_3O_2)_2$

CH

0.02 gms. $Co(C_2H_3O_2)_2$ are dissolved in one liter of a saturated solution in Furfural at 25°; 0.01 gms. $Co(C_2H_3O_2)_2 \cdot 4H_2O$ dissolve under the same conditions (Trimble, 1941).

COBALT PYRIDINE - RHODINATE $C_5H_5NCoCNS$?

CH

0.00373 mols. are dissolved in one liter of a saturated solution in Water. 0.0117 mols. are dissolved in one liter of a saturated solution in Absolute Alcohol (probably at 20°). Treadwell and Ammann, 1938.

COBALT ANTHRANILATE $Co(H_2NC_6H_4COO)_2$

CH

0.00412 mols. are dissolved in one liter of a saturated solution in Water which is 1N with acetic acid (probably at 20°). Treadwell and Ammann, 1938.

COBALT CUPFERRON $Co(C_6H_5N(NO)O)_2$

CH

0.0107 mols. are dissolved in one liter of a saturated solution in Water which is 0.01 N with acetic acid (probably at 20°). Treadwell and Ammann, 1938.

CNS **COBALT THIOCYANATE** $Co(CNS)_2$

SOLUBILITY OF COBALT THIOCYANATE IN METHYL THIOCYANATE
(Gillis and Sweemer, 1934)

t°	% $Co(CNS)_2$	Solid Phase	t°	% $Co(CNS)_2$	Solid Phase
-53.55	0.0	CH_3CNS	0	22.17	$2CH_3CNS \cdot Co(CNS)_2$
-53.8	6.6	"	25	23.4	"
-54.5	10.8	"	35	25.2	"
-54.8	12.8	"	37	27.3	"
-57.2	18	"	38	-	$2CH_3CNS \cdot Co(CNS)_2 + Co(CNS)_2$
-58	19	"	39	28.0	$Co(CNS)_2$
-60	21.5	"	41	28.8	"
-59.2	19.9	"	45	28.1	"
-59.8	20.8	"	50	28.2	"
-61.2	21.9	$CH_3CNS + 2CH_3CNS \cdot Co(CNS)_2$	55	28.2	"
			65	28.25	"
			70	28.3	"

CNS **COBALT Mercuri THIOCYANATE** $CoHg(CNS)_4$

The system $CoHg(CNS)_4 + ZnHg(CNS)_4$ was studied by Stahl and Straumanis, 1943, and Straumanis and Stahl, 1943.

CO **COBALT CARBONATE** $CoCO_3$

SOLUBILITY IN WATER CONTAINING CARBON DIOXIDE
(Smurov, 1938)

Partial Pressure CO_2 (Atm.)	Gms. Co per 100 gms. Saturated Solution				
	5	15	40	50	80
0.0005	0.0143	0.0109	0.0021	0.0013	0.0005
.005	.0335	.0256	.0050	.0031	.0013
.05	.0786	.0599	.0117	.0073	.0030
.10	.1016	.0775	0151	.0094	.0039
Total Pressure $CO_2 + H_2O$ = 1 Atm.	.2382	.1816	.0354	.0220	.0091

COS **COBALT XANTHATE** $Co(SCSOH)_2$ (?)

SOLUBILITY OF COBALT XANTHATE IN ORGANIC SOLVENTS AT ROOM TEMPERATURE
(Kutzelnigg, 1948)

Solvent	Gms. Cobalt Xanthate per liter of Solvent	Solvent	Gms. Cobalt Xanthate per liter of Solvent
Lacquer Benzine	4	1:1 by volume Benzene + Cyclohexanone	10
Ethyl Alcohol	4	Dioxane 9:1 by volume Xylene + Dioxane	150
Iso Butyl Alcohol	2	Methylene Chloride	280
Acetone	21	Ethylene Trichloride	110
Methyl Glycol	24	Carbon Tetra Chloride	92
Benzene	200	Dioxane	124
Xylene	32	Carbon Disulfide	85
Toluene	150		
Cyclohexanone	380		

COBALT CHLORIDE $CoCl_2$

THE SYSTEM COBALT CHLORIDE - AMMONIUM CHLORIDE - WATER

The data on this system leaves the exact nature of the solid phases at room temperature somewhat in doubt. The various investigators agree upon the compositions of the saturated solutions, but disagree on what solid phases are present. In general, it seems fairly well established that:

(1) The system is "simple" at low temperatures, and the only solids present are NH_4Cl and $CoCl_2 \cdot 6H_2O$.

(2) Above 20° or 30° the compound $2NH_4Cl \cdot CoCl_2 \cdot 2H_2O$ exists and that it forms solid solutions with its components.

At 25°, Foote, 1912 (Vol. I, p. 411) found that the solid phases were $CoCl_2 \cdot 6H_2O$ and a solid solution of $CoCl_2$ in NH_4Cl(plus $2H_2O$). Very similar analytical data were obtained by Kurnakow, Luschnaja, and Kusnetzow (1937), but these authors reported that, in addition, the compound 2:1:2 was formed. They based their claim on relatively little data, and it seems inconclusive on this point. Benrath and Neuman, (1939) found neither the solid solution nor the double salt at 25°, and report the system to be simple.

At 60° Clendinnen (Vol. I, p. 412) found that the compound 2:1:2 was stable as a pure solid phase in contact with solutions containing 11-17% NH_4Cl. Solutions containing more or less NH_4Cl were in equilibrium with solid solutions.

Kurnakow, Luschnaja, and Kusnetzow studied the system at 50° and found closely agreeing results. In addition, they found that pure $CoCl_2 \cdot 2H_2O$ existed in equilibrium with a range of solution compositions, and that it saturated an invariant solution with one of the solid solutions. This explained the rather sharp change in slope also found in Clendinnen's solubility curve, which had not been interpreted by him.

Benrath and Neumann studied the system at 12 temperatures above 25°, including 50°, and although their analytical data agrees in part with those of Kurnakow, etal., their interpretation is quite different. They were apparently unaware of the results of Kurnakow, etal.

Benrath found the same four segments of the solubility curve which Kurnakow had described as the saturation curves of the phases: (1) Solid Solution (2) $2NH_4Cl \cdot CoCl_2 \cdot 2H_2O$ (3) Solid Solution (4) $CoCl \cdot 2H_2O$

(1) Instead of a solid solution of $CoCl_2$ in NH_4Cl (found by all other workers) Benrath, using the method of wet residues, found only pure NH_4Cl to exist from 0° to 75°. At 100°, some solid solution was formed.

(2)(3) The actual data for the rest of the system appear to confirm Kurnakow's conclusions as to the existence of the 2:1:2 compound and a second solid solution, but it has not been so interpreted by the authors. Benrath and Neumann report the formation of two compounds 2:1:2 and $NH_4Cl \cdot CoCl_2 \cdot 2H_2O$, and say that both of the compounds form solid solutions with each component, and do not exist as pure phases. Part of the disparity is due to lack of sufficient data along certain portions of the curves.

(4) Both investigators found $CoCl_2 \cdot 2H_2O$ to exist.

$CoCl_2 + NH_4Cl + H_2O$ AT 0°, 25°, 50°

The data at 0° are those of Benrath and Neumann, (1939) and at 25° and 50° of Kurnakow, Luschnaia, and Kusnetzow, (1937):

Saturated Solution			Wet Residue		Solid Phase
Density	Wt.% NH_4Cl	Wt.% $CoCl_2$	Wt.% NH_4Cl	Wt.% $CoCl_2$	
		Results at 0°			
-	1.49	30.6	0.31	52.0	$CoCl_2 \cdot 6H_2O$
-	4.37	29.4	0.34	53.2	"
-	7.42	28.0	2.02	52.0	"
-	7.35	27.8	23.5	39.3	$CoCl_2 \cdot 6H_2O + NH_4Cl$
-	7.27	27.9	81.4	6.57	"
Cl -	8.71	22.5	85.5	3.37	NH_4Cl
-	13.89	13.43	90.8	1.45	"
-	18.43	6.01	90.7	0.86	"
-	21.7	1.75	91.0	0.71	"
-	22.0	1.06	88.3	0.38	"
		Results at 25°			
-	28.50	-	100.00	-	NH_4Cl
1.111	25.65	3.89	99.60	0.27	S.S. of $NH_4Cl + CoCl_2 +$
1.142	22.90	7.34	99.51	0.51	" $2H_2O$ (α)
1.187	19.51	12.76	93.89	1.54	"
1.223	17.46	16.36	89.19	3.42	"
1.248	16.03	18.94	95.18	3.40	"
1.304	13.54	24.17	84.18	9.27	"
1.331	13.01	26.02	76.02	17.02	"
1.364	11.85	28.57	71.36	22.50	"
1.381	11.20	30.18	68.44	23.66	"
1.380	11.32	30.71	68.86	24.03	"
1.389	10.91	31.50	66.58	26.41	"
1.405	10.64	32.33	50.67	29.88	S.S.α + 2:1:2
1.416	9.52	32.96	33.59	36.35	"
1.403	9.42	32.38	33.61	42.91	2:1:2
1.415	9.46	32.30	40.44	46.43	"
1.425	7.64	34.49	18.40	48.71	2:1:2 + $CoCl_2 \cdot 6H_2O$
1.430	7.70	34.36	16.79	49.94	"
1.423	5.19	35.01	0.28	55.27	$CoCl_2 \cdot 6H_2O$
-	-	36.0	-	55.00	"
		Results at 50°			
-	30.50	-	100.00	-	NH_4Cl
1.128	30.14	5.34	99.61	0.35	Solid Solution α
1.272	21.26	20.63	85.28	9.06	"
-	18.66	26.46	71.93	22.62	"
1.376	16.56	30.10	58.98	30.49	"
1.393	15.66	31.51	56.05	35.62	"
1.401	13.41	32.24	35.51	45.90	2:1:2
1.426	11.71	34.23	37.53	47.34	"
1.423	12.57	34.44	38.40	48.50	"
1.485	9.16	39.31	35.11	48.12	"
1.471	10.16	37.76	36.78	39.41	"
1.503	8.31	40.81	28.88	52.14	Solid Solution β

Saturated Solution			Wet Residue		Solid Phase
Density	Wt. % NH_4Cl	Wt. % $CoCl_2$	Wt. % NH_4Cl	Wt. % $CoCl_2$	
		Results at 50° (Con.)			
1.525	7.28	42.17	29.69	55.76	Solid Solution β
1.530	7.11	42.16	27.24	57.07	"
1.562	4.76	44.74	22.67	59.99	"
1.571	4.53	45.79	22.74	61.06	"
1.597	2.92	47.88	12.49	64.99	S.S. β + $CoCl_2 \cdot 2H_2O$
1.606	2.88	48.14	8.94	68.93	"
-	3.28	46.70	2.21	60.10	$CoCl_2 \cdot 2H_2O$
-	-	48.00	-	78.00	"

2:1:2 = $2NH_4Cl \cdot CoCl_2 \cdot 2H_2O$ Cl

EQUILIBRIUM IN THE SYSTEM COBALT CHLORIDE - POTASSIUM CHLORIDE - WATER

(Benrath and Ritter, 1939)

Gms. per 100 gms. Saturated Solution		Gms. per 100 gms. Wet Residue		Solid Phase
$CoCl_2$	KCl	$CoCl_2$	KCl	
		Results at 0°		
3.95	18.58	0.71	78.0	KCl
12.60	12.33	-	-	"
16.05	10.22	3.28	82.4	"
28.4	5.44	35.6	8.06	KCl + $CoCl_2 \cdot 6H_2O$
		Results at 38°		
39.3	4.00	-	-	$CoCl_2 \cdot 6H_2O$
40.2	6.92	51.9	9.95	"
40.0	8.60	44.5	14.30	KCl + $CoCl_2 \cdot 6H_2O$
33.8	9.55	8.41	77.0	KCl
25.5	12.46	7.10	75.9	"
15.3	17.52	3.65	80.7	"
7.67	22.9	1.17	86.7	"
		Results at 50°		
3.71	26.9	-	-	KCl
11.95	20.8	2.14	86.7	"
28.9	12.52	5.85	82.8	"
34.1	11.92	5.53	86.4	"
38.6	11.12	7.03	53.3	"
41.1	12.25	11.19	49.0	KCl + S.S.
40.5	12.82	39.6	44.0	"
45.9	6.39	39.5	17.50	S.S.
47.0	5.16	49.1	4.26	S.S. + $CoCl_2 \cdot 4H_2O$
47.9	3.34	50.3	Trace	$CoCl_2 \cdot 4H_2O$
46.9	2.45	62.5	"	"

Gms. per 100 gms. Saturated Solution		Gms. per 100 gms. Wet Residue		Solid Phase
$CoCl_2$	KCl	$CoCl_2$	KCl	
		Results at 51°		
15.2	18.65	2.92	86.5	KCl
30.4	12.25	4.38	88.4	"
36.2	12.39	1.53	94.6	"
40.7	12.56	31.8	53.8	KCl + S.S.
42.6	10.61	56.4	24.1	S.S.
45.1	7.70	57.9	21.5	"
45.2	7.55	52.6	22.2	"
46.5	6.01	58.6	14.31	"
47.0	5.20	61.4	6.95	S.S. + $CoCl_2 \cdot 4H_2O$
46.8	4.95	63.4	Trace	$CoCl_2 \cdot 4H_2O$
47.3	0.50	62.0	"	"
		Results at 75°		
2.87	30.8	-	-	KCl
7.81	27.5	-	-	"
22.9	20.2	4.80	84.0	"
29.6	17.65	8.12	78.4	"
35.7	20.6	7.98	83.3	"
37.2	19.5	7.80	84.1	"
38.0	23.1	6.78	88.6	"
40.9	22.9	41.0	38.6	KCl + S.S.
40.4	28.1	39.2	47.4	"
41.4	23.1	48.8	34.8	S.S.
43.3	19.30	51.6	24.8	"
43.5	16.00	52.5	27.4	"
44.6	15.27	54.5	22.7	"
45.8	11.85	56.3	19.62	"
48.0	8.18	56.0	13.20	"
49.0	5.92	59.9	7.40	S.S. + $CoCl_2 \cdot 2H_2O$
50.1	1.19	72.9	Trace	$CoCl_2 \cdot 2H_2O$
		Results at 99.5°		
7.58	30.8	2.39	81.6	KCl
15.80	28.8	2.78	92.0	"
21.4	27.6	5.86	82.5	"
29.2	25.1	5.77	87.2	"
28.5	27.8	4.83	89.3	"
32.9	27.9	7.00	86.0	"
36.7	28.6	21.9	59.9	"
40.5	36.1	25.7	63.7	KCl + S.S.
41.4	31.5	43.2	50.4	KCl (Blue) + S.S.
43.0	32.4	49.2	35.9	S.S.
44.6	26.4	51.1	26.1	"
47.0	17.95	58.9	16.08	"
49.0	11.74	64.9	10.45	"
50.6	7.00	65.1	3.96	S.S. + $CoCl_2 \cdot 2H_2O$
49.1	4.90	74.1	Trace	$CoCl_2 \cdot 2H_2O$
51.1	3.24	66.3	1.48	"
51.4	2.85	69.9	0.69	"

S.S. = Solid Solution

Data are also given for the system $CoCl_2 + K_2SO_4 \rightleftharpoons CoSO_4 + K_2Cl_2$ in Water at various temperatures.

EQUILIBRIUM IN THE SYSTEM COBALT CHLORIDE - COBALT SULFATE - WATER

(Benrath and Ritter, 1939)

t°	Gms. per 100 gms. Sat. Sol. $CoCl_2$	Gms. per 100 gms. Sat. Sol. $CoSO_4$	Solid Phase
0	29.4	4.03	$CoSO_4 \cdot 7H_2O + CoCl_2 \cdot 6H_2O$
	28.9	2.53	"
	19.50	4.96	$CoSO_4 \cdot 7H_2O$
	12.40	8.43	"
	11.53	8.74	"
	3.13	16.00	"
38	37.4	3.70	$CoCl_2 \cdot 6H_2O$
	36.4	4.70	$CoCl_2 \cdot 6H_2O + CoSO_4 \cdot 6H_2O$
	36.3	4.85	"
	32.8	7.33	$CoSO_4 \cdot 6H_2O$
	30.4	7.25	"
	28.2	7.52	"
	25.4	9.25	"
	21.8	10.56	"
	20.2	12.26	"
	21.9	11.28	"
	17.71	13.64	"
	13.91	17.11	$CoSO_4 \cdot 6H_2O + CoSO_4 \cdot 7H_2O$
	10.24	18.99	$CoSO_4 \cdot 7H_2O$
	8.72	21.2	"
	3.97	26.9	"
50	6.18	26.9	$CoSO_4 \cdot 6H_2O$
	6.79	26.2	"
	12.95	19.80	"
	22.3	13.60	"
	32.3	8.69	"
	32.9	9.36	$CoSO_4 \cdot 6H_2O + CoSO_4 \cdot H_2O$
	39.7	5.95	"
	43.5	6.09	$CoSO_4 \cdot 6H_2O + CoCl_2 \cdot 4H_2O$
	43.3	6.35	"
50	21.8	13.18	$CoSO_4 \cdot H_2O$
	34.9	5.18	"
	35.7	6.65	$CoSO_4 \cdot 6H_2O + CoSO_4 \cdot H_2O$
	43.4	3.89	$CoSO_4 \cdot H_2O + CoCl_2 \cdot 4H_2O$
	45.0	2.80	$CoCl_2 \cdot 4H_2O$
51	43.9	3.89	$CoSO_4 \cdot H_2O + CoCl_2 \cdot 4H_2O$
63.5	7.20	20.2	$CoSO_4 \cdot 6H_2O + CoSO_4 \cdot H_2O$
75	1.35	34.5	$CoSO_4 \cdot H_2O$
	9.03	25.9	"
	12.79	20.3	"
	18.45	15.70	"
	20.0	13.00	"
	20.8	6.43	"
	41.5	3.40	"
	43.1	2.53	"
	50.2	2.18	$CoCl_2 \cdot 2H_2O + CoSO_4 \cdot H_2O$
	47.6	2.56	"
	48.2	1.75	$CoCl_2 \cdot 2H_2O$
99.5	52.6	0.48	$CoCl_2 \cdot 2H_2O + CoSO_4 \cdot H_2O$
	50.8	1.82	"
	49.2	4.30	"
	39.0	2.37	$CoSO_4 \cdot H_2O$
	26.0	5.85	"
	30.1	4.39	"
	23.2	7.46	"
	12.21	15.58	"
	6.47	20.4	"
	5.57	21.4	"
	2.82	26.8	"

SOLUBILITY OF COBALT (ous) CHLORIDE IN VARIOUS ORGANIC SOLVENTS AT 25°

(Garwin and Hixson, 1949)

Solvent	Gms. $CoCl_2$ per 100 gms. Sat. Sol.	Solvent	Gms. $CoCl_2$ per 100 gms. Sat. Sol.
n-Butyl Alcohol	34.6	Methyl Ethyl Ketone	2.13
n-Amyl Alcohol	32.2	Methyl n-Propyl Ketone	1.20
2-Methyl-4-Butanol	29.2	Methyl Iso Butyl Ketone	0.41
n-Hexyl	29.0	Diethyl Ketone	.53
2-Ethyl-1-Butanol	27.3	Diiso Propyl Ketone	.52
2-Ethyl-1-Hexanol	26.2	Acetophenone	.33
Capryl-2-Octanol:		Ethyl Ether	.021
"Commercial"	21.3	Iso Propyl Ether	.01
"Ketone Free"	22.4	n-Heptane	.04
Ethyl Acetate	1.08	Benzene	.02
Iso Propyl Acetate	0.93	Nitro Methane	.01
Iso Valeric Acid	2.3	Nitrobenzene	.02
Benzaldehyde	0.29	Ethylene Dichloride	.00
Furfural	0.06	Chlorobenzene	.02

The anhydrous salt was used throughout. The solubility of Nickel Chloride in the same solvents is listed on p.492.

DISTRIBUTION OF COBALTOUS CHLORIDE BETWEEN CAPRYL ALCOHOL AND WATER AT 25°

(Garwin and Hixson, 1949)

Cl

Results are also given for mixtures of $CoCl_2$ + $NiCl_2$

Aqueous Phase Wt. % $NiCl_2$	Alcohol Phase Wt. % $CoCl_2$
35.6	0.0669
33.2	.0400
30.7	.0297
27.6	.0097

DISTRIBUTION OF COBALT CHLORIDE BETWEEN CAPRYL ALCOHOL AND WATER AT 25° IN THE PRESENCE OF HYDROCHLORIC ACID

(Garwin and Hixson, 1949a)

In each experiment the aqueous phase contained 9-13 wt. % $CoCl_2$. Data are also given for the distributions in the presence of $CaCl_2$, $NiCl_2$ and mixtures of $NiCl_2$ + $CaCl_2$.

Wt. % Total Cl in Aqueous Phase	K Co $\frac{\text{Alc.}}{\text{Aq.}}$	K HCl $\frac{\text{Alc.}}{\text{Aq.}}$	Wt. % Total Cl in Aqueous Phase	K Co $\frac{\text{Alc.}}{\text{Aq.}}$	K HCl $\frac{\text{Alc.}}{\text{Aq.}}$
9.7	0.29×10^{-3}	0.112	24.5	1.76×10^{-1}	.422
12.1	.66 "	.202	25.6	2.40 "	.425
14.0	1.50 "	.282	26.4	2.94 "	.425
15.3	2.23 "	.329	26.7	3.26 "	.435
16.4	5.06 "	.364	27.2	3.40 "	.430
17.5	8.35 "	.395	27.7	3.43 "	.447
19.1	1.68×10^{-2}	.398	28.1	3.82 "	.448
20.1	3.06 "	.400	29.1	4.15 "	.444
21.4	5.48 "	.416	31.3	4.93 "	.448
22.0	7.15 "	.410	31.6	4.92 "	.460
23.0	1.10×10^{-1}	.424			

One liter of a saturated solution of $CoCl_2 \cdot 6H_2O$ in furfural contains 5gms. $CoCl_2 \cdot 6H_2O$ at 25° (Trimble, 1941).

At 0°, 100 cc of a mixture of equal volumes of H_2O + $(C_2H_5)_2O$ saturated with HCl will dissolve 7.7 gms. of $CoCl_2$. - Fischer and Seidel, 1941.

Cl COBALT Choline CHLORIDE $(CH_3)_2NClC_2H_4CH \cdot CoCl_2$

0.1 gms. are dissolved in 100 ml. of solution in water at room temperature. (Seaman, Hugonet, and Leibmann, 1949).

COBALT HEXAMMINE FLUORIDE $[Co(NH_3)_6]F_3$

SOLUBILITY IN WATER

(Litvinov, 1940)

t°	Gms. $[Co(NH_3)_6]F_3$ per Liter Sat. Sol.
20	0.596
40	1.882
60	2.712
80	3.370
100	3.629

AQUO-COBALT PENTAMMINE FLUORIDE $[Co(NH_3)_5H_2O]F_3$

SOLUBILITY IN WATER

(Litvinov, 1940)

t°	Gms. $[Co(NH_3)_5H_2O]F_3$ per Liter Sat. Sol.
18	5.890
40	13.323
75	25.332
100	34.443

Hexammine Cobaltic Iodate Trihydrate $[Co(NH_3)_6](IO_3)_3 \cdot 3H_2O$

Chloropentammine Cobaltic Iodate $[Co(NH_3)_5Cl](IO_3)_3$

Oxalato Tetrammine Cobaltic Iodate Monohydrate $[Co(NH_3)_4C_2O_4](IO_3)_3 \cdot H_2O$

Chloropentammine Cobaltic Chloride $[Co(NH_3)_5Cl]Cl_3$

Chloropentammine Cobaltic Oxalate $[Co(NH_3)_5Cl]C_2O_4$

SOLUBILITIES IN WATER, UREA, AND DIOXANE SOLUTIONS AT 18°

(Pedersen, 1941)

Mols. $\times 10^3$ of Salt per Liter of Saturated Solution

Mols. Urea or Dioxane per Liter of Solvent	A		B		C	D		E
	Urea	Dioxane	Urea	Dioxane	Urea	Urea	Dioxane	Urea
0.0	3.880	3.889	3.79	3.760	8.215	16.97	16.97	0.745
.2	–	3.509	3.94	–	–	–	–	–
.25	4.133	–	–	3.400	–	–	–	–
.3	–	–	–	–	–	–	–	.795
.333	–	–	–	–	–	17.72	15.66	–
.4	–	3.161	4.10	–	–	–	–	–
.5	4.394	–	–	3.070	9.02	–	–	–
.6	–	2.836	4.26	–	–	–	–	.852
.667	–	–	–	–	–	18.50	14.38	–
.75	4.662	–	–	2.772	–	–	–	–
.8	–	2.538	4.42	–	–	–	–	–
1.0	4.934	2.272	4.59	2.467	9.86	19.21	13.15	.941

A = $[Co(NH_3)_6](IO_3)_3 \cdot 3H_2O$ B = $[Co(NH_3)_5Cl](IO_3)_3$ C = $[Co(NH_3)_4C_2O_4](IO_3)_3 \cdot H_2O$ D = $[Co(NH_3)_5Cl]Cl_3$ E = $[Co(NH_3)_5Cl]C_2O_4$

NH The solubility of the Croceo Salt Tetranitrodiammino Cobaltiate in solutions of the corresponding Leuto Salt and NaCl at 18° is given by Bronsted and Williams, 1928.

CARBAMATO PENTAMMINO COBALT BROMIDE $[Co(NH_3)_5(OCONH_2)]Br_2$

At 20°, 22.91 gms. are dissolved in 100 ml. of saturated solution in Water.

CARBAMATO PENTAMMINO COBALT IODIDE $[Co(NH_3)_5(OCONH_2)]I_2$

At 20°, 8.63 gms. are dissolved in 100 ml. of saturated solution in Water.

CARBAMATO PENTAMMINO COBALT NITRATE $[Co(NH_3)_5(OCONH_2)](NO_3)_2$

At 20°, 2.555 gms. are dissolved in 100 ml. of saturated solution in Water.

CARBAMATO PENTAMMINO COBALT SULFATE MONOHYDRATE $[Co(NH_3)_5(OCONH_2)]SO_4 \cdot H_2O$

At 20°, 7.00 gms. are dissolved in 100 ml. of saturated solution in Water.

CARBAMATO PENTAMMINO COBALT DITHIONATE $[Co(NH_3)_5(OCONH_2)]S_2O_6$

At 20°, 0.0182 gms. are dissolved in 100 ml. of saturated solution in Water.

(All above) - Linhard and Flygare, 1943

O **COBALT OXIDE** CoO

The system $CoO + Rh_2O_3$ was studied at 1050° by Schenck and Finkener (1943).

Rigamonti (1946) studied the system $CoO + ZnO$ at 900° with X-Rays.

OH **COBALT HYDROXIDE** $Co(OH)_2$

Oka, 1940 found the solubility to be 1.4×10^{-5} moles per liter by potentiometric titration.

Nasanen, 1943 found the thermodynamic solubility product to be 1.3×10^{-15} by potentiometric determinations in Potassium Chloride Solutions.

EQUILIBRIUM IN THE SYSTEM COBALT OXIDE - COBALT SULFATE - WATER AT 18° O

(Gromov, 1948)

$CoSO_4$ Wt. %	Co gms. per Liter	Density	pH	Solid Phase
24.8	120.1	1.278	6.60	$CoO \cdot CoSO_4 \cdot pH_2O + CoSO_4 \cdot 7H_2O$
11.7	50.2	1.130	6.99	$CoO \cdot CoSO_4 \cdot H_2O$
6.7	27.4	1.073	7.10	"
2.48	9.7	1.030	7.26	"
1.47	5.7	1.019	7.34	"
0.91	3.5	1.015	7.38	"
0.52	2.0	1.010	7.49	"
0.0	0.0	1.000	8.5	$Co(OH)_2$ -

COBALT SULFIDE CoS S

Kapustinsky, 1940 calculated the solubility product of Cobalt Sulfide from free energy data, and found it to be 3.1×10^{-23}. The calculated solubilities at various pH values are as follows:

pH	3	5	7	9	11
Moles CoS per liter	5.4×10^{-4}	5.4×10^{-6}	7.7×10^{-8}	5.6×10^{-9}	5.6×10^{-10}

Donges, 1947 determined the solubility of Cobalt Sulfide as a function of the method of washing, time of exposure to air, and reagents used.

The system Co + S and the system CoS + NiS were studied by Schenck and von der Forst (1942).

The reaction of CoS + Cu_2O at 700° was studied by Schenck and Keuth, 1940.

COBALT SULFATE $CoSO_4$ SO

SOLUBILITY IN WATER

(Benrath, 1941)

t°	Gms. $CoSO_4$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $CoSO_4$ per 100 gms. Sat. Sol.	Solid Phase
115	47	$CoSO_4 \cdot H_2O$	185	30	$CoSO_4 \cdot H_2O$
135	45	"	205	20	"
153	41.5	"	205	10	"
170	37.2	"	205	5	"

Rohmer (1938) studied part of the system $CoSO_4$ - H_2SO_4 - H_2O in order to determine which hydrates were stable at different temperatures. Above 64.2°, he found only $CoSO_4 \cdot H_2O$, between 43.3° and 64.2° he found $CoSO_4 \cdot H_2O$ and $CoSO_4 \cdot 6H_2O$, and below 43.3° $CoSO_4 \cdot 7H_2O$, $CoSO_4 \cdot 6H_2O$, and $CoSO_4 \cdot H_2O$. Part of the diagram for the system at 70° is given.

EQUILIBRIUM IN THE SYSTEM COBALT SULFATE - POTASSIUM SULFATE - WATER AT VARIOUS TEMPERATURES

(Benrath and Ritter, 1939)

These data supplement those of Benrath (Vol. I, p. 435) at other temperatures. Many more points are given in the original paper.

t°	Gms. per 100 gms. Sat. Sol.		Solid Phase
	$CoSO_4$	K_2SO_4	
0	1.32	7.90	K_2SO_4 + 1:1:6
	3.83	3.81	1:1:6
	21.0	1.66	1:1:6 + $CoSO_4 \cdot 7H_2O$
38	4.70	13.31	K_2SO_4 + 1:1:6
	15.75	6.71	1:1:6
	31.0	3.8	1:1:6 + $CoSO_4 \cdot 7H_2O$
50	6.80	14.36	K_2SO_4 + 1:1:6
	10.32	12.01	1:1:6
	33.3	3.5	1:1:6 + $CoSO_4 \cdot 6H_2O$
75	13.51	17.90	K_2SO_4 + 1:1:6
	17.63	14.50	1:1:6
	34.5	7.32	1:1:6 + $CoSO_4 \cdot H_2O$
90	29.4	12.80	"
96	22.4	18.55	K_2SO_4 + 1:1:6
	24.4	16.57	1:1:6
	27.9	14.95	1:1:6 + $CoSO_4 \cdot H_2O$
99.5	22.6	18.50	K_2SO_4 + 1:1:4
	24.9	17.75	1:1:4
	25.6	17.50	1:1:4 + $CoSO_4 \cdot H_2O$

1:1:6 = $K_2SO_4 \cdot CoSO_4 \cdot 6H_2O$ 1:1:4 = $K_2SO_4 \cdot CoSO_4 \cdot 4H_2O$

SO **COBALT Potassium SULFATE** $CoSO_4 \cdot K_2SO_4 \cdot 6H_2O$

At 25°, Hill, Durham, and Ricci (1940) found the solubility to be 13.65 gms. of anhydrous salt per 100 gms. of saturated solution (Density = 1.128, Molarity = 0.4679).

EQUILIBRIUM IN THE SYSTEM COBALT POTASSIUM SULFATE - COPPER POTASSIUM SULFATE - WATER AT 25°

(Hill, Durham, and Ricci, 1940)

Each point is the average of two closely agreeing results, one of which was obtained by dissolving the Cobalt Salt completely before adding the Copper Salt, and the second of which was obtained by reversing the order of addition of the salts. The solid solutions are of Roozeboom's Type I.

Saturated Solution		Solid Phase	
Wt. % $CoK_2(SO_4)_2$	Wt. % $CuK_2(SO_4)_2$	Wt. % $CoK_2(SO_4)_2$	Wt. % $CuK_2(SO_4)_2$
13.65	0.0	—	—
11.73	1.318	63.13	12.13
9.72	2.963	48.45	26.96
7.62	4.61	34.40	41.00
5.38	6.29	21.85	53.65
2.917	8.21	10.07	65.48
0.0	10.35	—	—

SeO

COBALT SELENATE $CoSeO_4$

SOLUBILITY OF COBALT SELENATE IN WATER
(Klein, 1940)

t°	Density	Gms. $CoSeO_4$ per 100 gms. Sat. Sol.	Gms. $CoSeO_4$ per 100 gms. H_2O	Solid Phase
-1.7	1.1705	15.40	18.20	Ice
-3.5	1.2764	23.47	30.66	"
-6.4	-	30.25	43.37	Ice + $CoSeO_4 \cdot 7H_2O$
0	1.4255	31.95	46.95	$CoSeO_4 \cdot 7H_2O$
10	1.4690	34.69	53.11	"
15	1.4786	35.48	54.99	$CoSeO_4 \cdot 6H_2O$
21.6	1.4911	36.12	56.54	"
26	1.4958	36.39	57.20	"
30	1.5050	36.80	58.60	"
*52.2	1.5411	39.72	65.89	"
*70	1.5722	41.48	70.88	"
*30	1.5100	37.42	59.79	$CoSeO_4 \cdot 4H_2O$
40	1.5104	37.54	60.10	"
50	1.5113	37.72	60.56	"
*60	1.5118	37.97	61.05	"
*80	1.3978	32.73	48.66	$CoSeO_4 \cdot H_2O$
84.5	1.3250	28.37	39.61	"
90	1.2505	23.94	31.47	"
95	1.1992	20.44	27.79	"
100	1.1622	17.98	21.92	"

*Indicates Metastable

CHROMIUM Cr

Cr

The systems Cr + As, Cr + S, Cr + Se, and Cr + Te were studied magnetically by Haraldsen and Nygaard (1939).

CHROMIUM CHLORIDE $CrCl_3$

Cl

A mixture of equal volumes of Diethyl Ether and Water at 0° when saturated with HCl will dissolve 0.03 gms. Green $CrCl_3$ or 0.0057 gms. Violet $CrCl_3$ in 100 cc of the mixture. Fischer and Seidel (1941).

CHROMIC NITRATE $Cr(NO_3)_3$

NO

Smith, 1945 determined the solubility in water at 25° and found:

From Undersaturation: 44.95 gms. per 100 gms. Sat. Sol.
From Supersaturation: 44.71 " " " " " "
Average: 44.83 " " " " " "

Analyses were made by oxidation of Chromium to Chromate and iodometric titration. The solid phase was $Cr(NO_3)_3 \cdot 9H_2O$.

OH CHROMOUS HYDROXIDE $Cr(OH)_2$

Hume and Stone (1941) found that a basic salt precipitated from a solution of $CrCl_2$ at pH 5.8. Using a method similar to that of Britton (Vol. I, p. 446), and assuming the precipitate to be $Cr(OH)_2$, the solubility product was found to be 5×10^{-19}. Upon addition of equivalent quantities of acid and base to precipitate $Cr(OH)_2$, the observed Ksp was 1×10^{-17}, but the authors point out that although these values may be of practical importance, the existence of various basic salts in the precipitate makes an exact interpretation impossible.

O CHROMIC OXIDE Cr_2O_3

As part of a study of the system $Cr_2O_3 + ZnO$, Huttig and Theimer (1941) determined the solubility of Cr_2O_3 in dilute HCl and H_2SO_4 after the oxide had been heated to various temperatures.

The following systems have been investigated:

$Cr_2O_3 + NiO$ (1:1 compound) Thomassen (1940)
$Cr_2O_3 + NiO + ZrO_2$ (by X-Rays) Milligan and Watt (1948)
$Cr_2O_3 + Fe_2O_3$ (as gels) Milligan and Merten (1947)
$Cr_2O_3 + Cu_2O$ Schenck and Keuth (1940)

OH CHROMIUM HYDROXIDE $Cr(OH)_3$

Oka, 1940 found the solubility to be 1.2×10^{-8} moles per liter by potentiometric titration.

SO CHROMIUM Ammonium SULFATE $CrNH_4(SO_4)_2$

EQUILIBRIUM IN THE SYSTEMS

CHROMIUM AMMONIUM SULFATE - IRON AMMONIUM SULFATE - WATER AND
CHROMIUM AMMONIUM SULFATE - ALUMINUM AMMONIUM SULFATE - WATER AT 25°

(Smith and Lennox, 1948)

Each pair of alums exhibits continuous solid solutions of Roozeboom's Type I. Each point was established by duplicate determinations, in which the order of addition of the salts was reversed. The solid solutions contain 12 molecules of water per mol. of salts.

Saturated Solution		Solid Phase	
Wt. % $CrNH_4(SO_4)_2$	Wt. % $FeNH_4(SO_4)_2$	Wt. % $CrNH_4(SO_4)_2$	Wt. % $FeNH_4(SO_4)_2$
0.0	31.20	0.0	55.17
0.332	29.55	3.789	50.46
0.745	28.71	7.992	47.13
1.153	27.58	11.45	41.21
1.788	25.62	17.26	37.20
2.692	23.29	23.55	31.34
4.546	19.02	33.39	20.18
7.402	12.09	44.26	10.39
10.30	6.081	49.68	4.562
13.66	0.0	54.81	0.0

Saturated Solution		Solid Phase	
Wt. % $CrNH_4(SO_4)_2$	Wt. % $AlNH_4(SO_4)_2$	Wt. % $CrNH_4(SO_4)_2$	Wt. % $AlNH_4(SO_4)_2$
0.0	6.15	0.0	52.31
2.761	4.826	6.44	46.27
5.318	3.478	15.67	37.05
8.00	2.374	25.94	27.31
10.19	0.967	37.14	19.61
11.98	0.610	43.99	8.99
13.66	0.0	54.81	0.0

CESIUM BROMIDE CsBr

Br

THE TERNARY SYSTEMS CESIUM BROMIDE - IODINE - TOLUENE AND CESIUM BROMIDE - IODINE - BENZENE AT 6°

(Foote and Fleischer, 1940)

$CsBr - I_2$ - Toluene		$CsBr - I_2$ - Benzene	
Gms. I per 100 gms. Sat. Sol.	Solid Phase	Gms. I per 100 gms. Sat. Sol.	Solid Phase
0.98	$CsBr + CsBrI_2$	0.82	$CsBr + CsBrI_2$
1.51	$CsBrI_2$	1.43	$CsBrI_2$
9.63	"	5.82	"
10.36	$CsBrI_2 + I_2$	7.74	"
		8.69	$CsBrI_2 + I_2$

Reactions between the dry salts below their melting points have been studied by Link and Wood, 1940 for the following:

CsBr + LiF	CsBr + LiI
CsBr + LiCl	CsBr + KF
CsBr + NaF	CsBr + RbF
	CsBr + KCl

The equilibrium concentrations of the salts in the reaction CsBr + KCl $\rightleftharpoons$ CsCl + KBr at 400° and 477° were determined by Vogt and Wood (1944). The concentrations were found by means of X-Rays.

CESIUM DIPICRYLAMINATE $Cs[(NO_2)_3C_6H_2NHC_6H_2(NO_2)_3]$

CH

SOLUBILITY IN WATER

(Treadwell and Hepenstrick, 1949)

20°	176	Mg. per liter
25°	257	"

CESIUM CHLORIDE CsCl

Cl

SOLUBILITY OF CESIUM CHLORIDE IN LIQUID SULFUR DIOXIDE

(Shatenstein and Viktorov, 1937)

At 25°, 100 gms. of saturated solution contain 0.294 gms. CsCl.

Link and Wood, 1940 studied the reactions between the dry salts below. the melting points for the following pairs:

CsCl + LiF	CsCl + LiBr
CsCl + NaF	CsCl + LiI
CsCl + KF	CsCl + RbF
	CsCl + KBr

Melting points in the system CsCl + $CsVO_3$ were determined by Schmitz-Dumont and Schmitz (1944)

Cl CESIUM Antimony CHLORIDE $3CsCl \cdot 2SbCl_3$

SOLUBILITY IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS AT 25°

(Bender, 1945)

It was found that the yellow or brown color sometimes assumed by this salt was due to traces of Thallium of the order of 0.005%.

Solvent	Gms. $3CsCl \cdot 2SbCl_3$ per		Solvent	Gms. $3CsCl \cdot 2SbCl_3$ per	
Gm. Moles HCl per 1000 gms. H_2O	100 gms. Solvent	100 ml. Sat. Sol.	Gm. Moles HCl per 1000 gms. H_2O	100 gms. Solvent	100 ml. Sat. Sol.
2.086	1.732	1.778	6.875	1.114	1.217
2.953	1.389	1.444	9.957	1.083	1.218
4.027	1.236	1.304	12.92	1.093	1.253
4.869	1.178	1.256	16.20	1.134	1.333

ClO CESIUM CHLORATE $CsClO_3$

0.29 moles $CsClO_3$ dissolve in 1000 gms. of water. (Probably at 20°). (Treadwell and Ammann, 1938)

ClO CESIUM PERCHLORATE $CsClO_4$

0.069 moles $CsClO_4$ dissolve in 1000 gms. of water. (Probably at 20°). (Treadwell and Ammann, 1938)

F CESIUM FLUORIDE CsF

SOLUBILITY OF CESIUM FLUORIDE IN HYDROGEN FLUORIDE

(Winsor and Cady, 1948)

Four compounds were found in the system, and the authors report the temperatures of their melting points, and of the eutectic points between them. All other data given below were read from the phase diagram given by the authors.

t°	Mol. % HF	Solid Phase	t°	Mol. % HF	Solid Phase
-50	83	$CsF \cdot 6HF$	30	70	$CsF \cdot 2HF$
-42.3 (M.P.)	85.7	"	50.2 (M.P.)	66.7	"
-49.5	82.8	$CsF \cdot 6HF + CsF \cdot 3HF$	38.3	63.9	$CsF \cdot 2HF + CsF \cdot HF$
-30	82	$CsF \cdot 3HF$	60	60	$CsF \cdot HF$
0	80	"	100	57	"
20	78	"	150	53	"
32.6 (M.P.)	75.0	"	176. (M.P.)	50.0	"
16.9	70.9	$CsF \cdot 3HF + CsF \cdot 2HF$	151.5	45.3	$CsF \cdot HF + CsF$

Melting points in the systems CsF + AlF_3, CsF + LaF_3, and CsF + YF_3 are given by Dergunov (1948). The compound $3CsF \cdot XF_3$ is found in each.

Melting points in the system CsF + $CsVO_3$ were determined by Schmitz-Dumont and Schmitz (1944).

The reactions below the melting points were determined for the following solid salt pairs by Link and Wood, 1940.

CsF + LiCl	CsF + NaCl	CsF + KCl	CsF + RbCl
CsF + LiBr	CsF + NaBr	CsF + KBr	CsF + RbBr
CsF + LiI	CsF + NaI	CsF + KI	CsF + RbI

CESIUM IODIDE CsI I

SOLUBILITY IN WATER
(Briggs and Hubard, 1941)

The authors determined the solubility in water at many temperatures, and present a table of data which includes the work of previous investigators.

t°	Gms. CsI per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. CsI per 100 gms. Sat. Sol.	Solid Phase
-1.2	8.76	Ice	25.0	46.1 (6)	CsI
-2.7	18.75	"	25.0	46.9 (7)	"
-4.0	27.45	Ice + CsI	32.0	49.98	"
-4.0	27.59 (1)	"	32.4	50.05	"
0.0	30.6 (2)	CsI	35.6	51.48 (1)	"
1.4	31.41	"	45.9	55.54	"
9.3	36.90	"	59.3	60.43	"
14.0	39.8 (2)	"	61.0	60.0 (2)	"
15.0	40.3 (3)	"	61.3	60.75	"
16.0	41.13 (4)	"	77.7	65.24	"
19.4	43.32	"	88.0	67.16	"
22.8	47.94 (5)	"	102.8	70.25	"
			109.1	71.48 (Boiling Point)	"

(1) Foote, Am. Chem. J. 29, 203 (1903)
(2) Beketoff, Bull. Acad. St. Petersburg [4] 4, 198 (1894)
(3) Setterberg, in Gemelin's Handbuch der anorganischen Chemie, System, Nr. 25 (Cesium) Vol. 2, p. 200; Berlin, 1938.
(4) Lannung, Z. physik. Chem. A170, 134 (1934)
(5) Buchanan, Am. J. Sci. [4] 21, 32 (1906)
(6) Briggs, Greenwald, and Leonard, J. Phys. Chem. 34, 1951 (1930)
(7) Fajans and Karagunis, from Meyer and Dunkel; Z. physik. Chem., Bodenstein festband, p. 556 (1931)

THE SYSTEM CESIUM IODIDE - IODINE - WATER
(Briggs and Hubard, 1941)

Below 51.6°, the diagram of the system consists of the saturation curves of the four solid phases: CsI, CsI_3, CsI_4, and I_2. Above this temperature the curves are interrupted by a solid immiscibility gap, and in certain mixtures there are two different liquid phases in equilibrium. As the former, the temperature is increased, the solids become more soluble, and the two-liquid region covers a major part of the diagram. Above 80.6° the

Cesium Salts become so soluble that their saturation curves no longer intersect the liquid immiscibility gap, and there is again only one liquid phase in the system.

The boiling points of the various solutions were determined and are presented in a diagram. CsI_3 is congruently soluble above 80°, and CsI_4 from 79.5° to 89°. The data agree with those of Foote (1903), Briggs (1930), and Briggs and Greenwald (1930) [Vol. I, pp. 459, 460, 462], except that the Pentaiodide of Foote has since been shown to be the Tetraiodide.

	t°	Gms. I per 100 gms. Sat. Sol.	Gms. CsI per 100 gms. Sat. Sol.	Solid Phase
I	-0.2	0.34	0.88	Ice + I_2 + CsI_4
	-0.3	.42	1.46	Ice + CsI_4
	-0.4	.38	2.63	"
	-0.5	.31	3.47	Ice + CsI_4 + CsI_3
	-0.8	.21	5.30	Ice + CsI_3
	-2.2	.08	15.07	"
	-2.5	.07	19.26	"
	-3.2	.05	23.60	"
	-4.0	.06	27.78	Ice + CsI + CsI_3
	3.8	.09	33.51	CsI + CsI_3
	12.0	.16	39.39	"
	20.0	.29	44.14	"
	25.0	.38	46.4	"
	34.6	.64	51.23	"
	48.5	1.22	56.52	"
	60.8	2.05	60.41	"
	7.2	0.44	4.34	CsI_3 + CsI_4
	9.0	0.54	4.51	"
	25.0	1.19	7.65	"
	25.4	1.34	7.54	"
	44.1	2.93	13.03	"
	54.8	5.44	18.14	"
	57.8	5.85	18.97	"
	62.0	8.54	22.31	"
	69.4	12.52	26.15	"
	71.9	15.41	29.44	"
	71.1	3.06	62.66	CsI + CsI_3
	80.1	4.62	64.90	"
	85.0	5.69	65.07	"
	90.0	7.19	65.43	"
	100.1	12.16	64.76	"
	105.4	16.23	63.40	"
	75.1	18.33	30.84	CsI_3 + CsI_4
	76.0	19.12	31.51	"
	77.8	23.95	33.53	"
	79.3	29.68	35.69	"
	79.6	34.67	37.14	"
	80.1	36.65	37.93	"
	80.4	40.04	38.41	"
	80.6	44.42	38.43	"
	81.0	48.48	38.88	"
	82.2	51.70	38.61	"
	84.5	53.87	38.66	"
	88.0	56.28	38.14	"
	95.2	59.10	37.39	"
	103.3	61.36	36.26	"

t°	Gms. I per 100 gms. Sat. Sol.	Gms. CsI per 100 gms. Sat. Sol.	Solid Phase
6.4	0.75	1.93	CsI_4 + I_2
25.0	1.23	2.39	"
27.6	1.57	3.24	"
36.4	2.24	4.28	"
48.0	3.39	6.06	"
51.5	4.09	6.93	CsI_4 + I_2 (+ 2 liquids)
51.5	74.33	23.24	"
60.6	77.50	21.07	CsI_4 + I_2
54.6	4.55	7.78	CsI_4 (+ 2 liquids)
65.0	7.69	12.36	"
67.3	8.93	13.87	"
70.9	10.01	16.37	"
72.3	11.80	18.09	"
74.4	13.90	20.71	"
74.9	14.78	21.25	"
76.7	17.31	24.16	"
78.2	19.16	26.38	"
79.5	24.34	31.27	"
80.0	26.49	32.61	"
80.4	28.50	34.31	"
80.6	38.22	36.92	"
80.6	48.18	37.98	"
80.0	52.85	37.27	"
79.5	53.60	37.22	"
79.4	55.77	36.28	"
77.0	59.47	34.01	"
73.9	64.48	31.23	"
67.0	68.17	28.12	"
56.4	72.90	24.64	"
74.1	4.15	6.08	I_2 (+ 2 liquids)
80.8	4.35	5.83	"
89.6	4.18	5.48	"
93.4	4.55	5.42	"
74.1	79.71	18.98	"
81.0	82.02	16.18	"
86.0	84.05	14.57	"
*98.2	3.84	4.58	"
*98.2	87.84	10.77	"
*100.6	24.97	21.03	(2 liquids)
*100.6	59.50	28.81	"
*109.3	9.76	66.30	CsI
*109.7	20.8	61.9	CsI + CsI_3
*108.9	24.57	57.83	CsI_3
*108.3	26.13	56.24	"
*108.1	26.55	55.64	"
*107.5	28.83	53.83	"
*107.0	35.38	49.85	"
*106.7	38.24	49.28	"
*106.2	42.42	46.42	"
*106.5	47.65	45.73	"
*122	51.00	46.93	"

* = Boiling point

I

SOLUBILITY OF CESIUM IODIDE IN ACETONE

(Evertz and Livingston, 1949)

Temp.	Gms. CsI per 100 gms. Sat. Sol.	Temp.	Gms. CsI per 100 gms. Sat. Sol.	Temp.	Gms. CsI per 100 gms. Sat. Sol.
-78.5°	0.36	-20°	0.35	25°	0.20
-60°	.38	0°	.29	30°	.18
-40°	.37	20°	.22	40°	.13

I CESIUM Dichloro IODIDE $CsCl_2I$

SOLUBILITY IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS
(Bender and Streblow, 1948)

Solvent: Gm. mols. HCl per 1000 gms. H_2O	Results at 0°: Gms. $CsCl_2I$ per 100 gms. Solution	Results at 0°: Gms. $CsCl_2I$ per 100 cc Solution	Results at 25°: Gms. $CsCl_2I$ per 100 gms. Solution	Results at 25°: Gms. $CsCl_2I$ per 100 cc Solution
0.8805	3.623	3.783	9.059	9.805
1.998	3.524	3.745	8.274	9.052
2.989	3.321	3.577	7.470	8.236
4.909	2.890	3.187	6.097	6.824
6.987	2.553	2.877	5.057	5.746
8.989	2.343	2.691	4.455	5.142
10.75	2.231	2.604	4.139	4.841
12.48	2.189	2.591	3.964	4.697
15.29	2.195	2.652	3.894	4.700

Link and Wood (1940) studied the reaction, below the melting points, for the following salt pairs:

CsI + LiF	CsI + NaF	CsI + LiCl
CsI + KF	CsI + LiBr	CsI + RbF

NO CESIUM NITRATE $CsNO_3$

SOLUBILITY IN H_2O AND D_2O AT 5°
(Noonan, 1948)

100 gms. of a saturated solution in ordinary water contain 10.44 gms. $CsNO_3$. This agrees with the work of Berkeley (Vol. I, p. 462).

100 gms. of a saturated solution in water containing 91.43% D_2O contains 8.17 gms. $CsNO_3$.

Melting points in the system Cesium Nitrate + Hydrazine Nitrate are given in a diagram by Barlot and Marsaule (1948).

MnO CESIUM PERMANGANATE $CsMnO_4$

0.009 moles of $CsMnO_4$ dissolve in 1000 gms. of water (Probably at 20°) (Treadwell and Ammann, 1938).

ReO CESIUM PERRHENATE $CsReO_4$

SOLUBILITY IN WATER
(Smith and Long, 1948)

t°	Gm. Moles per 100 gms. H_2O
0	0.000861
30	.00287
50.3	.00640

COPPER Cu

The following systems have been studied:

Cu + P	Maltsev (1939)
Cu + Ni + S	Köster and Mulfinger (1940)
Cu + $CuSO_4$ + Se	Goria (1940)

The distribution of Cu in the system Sn + SnS has been studied at 910° by Anderson and Ridge (1943). The Cu is concentrated preferentially in the sulfide phase.

COPPER BROMIDE $CuBr_2$ Br

Heines and Yntema, 1938 allowed 5 gms. of solid to stand in contact with 25 cc of anhydrous dioxane for two weeks at 26.5°, and found the solubility to be 0.075 gms. per 100 cc of saturated solution.

COPPER Tetrapyridine BROMIDE (cus) $[Cu_2(C_5H_5N)_4]Br_2$ Br

SOLUBILITY IN WATER
(Marukhyan, 1940)

t°	Gms. $(Cu_2(C_5H_5N)_4)Br_2$ per 100 ml. H_2O	t°	Gms. $[Cu_2(C_5H_5N)_4]Br_2$ per 100 ml. H_2O
25	0.25	50	0.36
30	.3	55	.41
35	.32	60	.423
40	.34	65	.45
45	.345	70	.49

SOLUBILITY OF $[Cu_2(C_5H_5N)_4]Br_2$ + $(Cu_2(C_5H_5N)_4)Cl_2$ IN WATER
(Marukhyan, 1940)

t°	Gms. $[Cu_2(C_5H_5N)_4]Br_2$ + $[Cu_2(C_5H_5N)_4]Cl_2$ per 100 ml. H_2O	t°	Gms. $[Cu_2(C_5H_5N)_4]Br_2$ + $[Cu_2(C_5H_5N)_4]Cl_2$ per 100 ml. H_2O
25	0.43	50	0.683
30	.5	55	.711
35	.61	60	.75
40	.64	65	.82
45	.65	70	.87

COPPER ACETATE (ic) $Cu(C_2H_3O_2)_2$ CH

SOLUBILITY OF COPPER (ic) ACETATE IN ACETIC ACID SOLUTIONS OF ACETAMIDE AT 35°
(Sisler, Davidson, Stoenner, and Lyon, 1944)

Mole Ratio $\frac{CH_3CONH_2}{CH_3CONH_2 + CH_3COOH}$	Mole % $Cu(C_2H_3O_2)_2$ in Sat. Sol. at 35°
0.000	0.31
.050	.43
.092	.55
.164	.78

CH **COPPER PYRIDINE-RHODINATE** $C_5H_5NCuCNS$?

0.00055 moles are dissolved in one liter of a saturated solution in water. c.0117 mols. are dissolved in one liter of a saturated solution in absolute alcohol. (Probably at 20°) (Treadwell and Ammann, 1938).

COPPER ANTHRANILATE $Cu(H_2NC_6H_4COO)_2$

0.000903 moles are dissolved in one liter of a saturated solution which is 1N with Acetic Acid. (Probably at 20°) (Treadwell and Ammann, 1938).

CH **COPPER CUPFERRATE** $Cu(C_6H_5N(NO)O)_2$

- The solubility product is 9.5×10^{-17} (Fyatnitski, 1946).

- 0.00013 moles are dissolved in one liter of a saturated solution in water which is 0.01 N with Acetic Acid. (Probably at 20°) (Treadwell and Ammann, 1938).

COPPER OXYQUINOLATE $Cu(C_9H_6ON)_2 \cdot 2H_2O$

0.000570 moles are dissolved in one liter of a saturated solution which is 1N with Acetic Acid (Probably at 20°) (Treadwell and Ammann, 1938).

CH **COPPER SALICYLALDOXIME** $Cu[HOC_6H_4CHNO]_2$

0.00022 moles are dissolved in one liter of a saturated solution which is 0.01 N with HCl. (Probably at 20°) (Treadwell and Ammann, 1938).

COPPER BENZOINOXIME $Cu[C_6H_5CHOHCNO(C_6H_5)]_2$

0.00078 moles are dissolved in one liter of a saturated solution which is 0.01 N with Acetic Acid. (Probably at 20°) (Treadwell and Ammann, 1938).

COPPER CITRATE $[(CH_2)_2COH(COO)_3]_2Cu_3$

At 25°, 0.17 gms. Copper Citrate dissolve in sea water of pH 8.1. (Ferry and Riley, 1946).

COPPER TETRACHLOROPHTHALATE $C_6Cl_4(COO)_2Cu$

Less than 0.10 gms. are dissolved in 100 gms. of a saturated solution in water at 25°. (Lawlor, 1947).

CO

COPPER CARBONATE Basic

$CuCO_3 \cdot Cu(OH)_2$ (Malachite) $2CuCO_3 \cdot Cu(OH)_2$ (Azurite)

SOLUBILITY OF EACH IN DISTILLED WATER CONTAINING CARBON DIOXIDE AT 20°

(Tronstad and Veimo, 1940)

$CuCO_3 \cdot Cu(OH)_2$	Gms. CO_2 per liter	0	0.29	0.88
	Mg. Cu per liter	0.3	21.0	34.0
$2CuCO_3 \cdot Cu(OH)_2$	Gms. CO_2 per liter	0	0.34	0.84
	Mg. Cu per liter	0.5	13.0	27.4

100 gms. of a saturated solution in sea water contain 5×10^{-7} gms. of freshly precipitated basic Copper Carbonate or less than 1×10^{-7} gms. basic Copper Carbonate which has been aged in sea water one year. (25°, pH = 8.1). Ferry and Riley, 1946.

CUPROUS CHLORIDE CuCl

Cl

SOLUBILITY OF CUPROUS CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS

(Morozov and Ustavshikova, 1944)

The authors present curves showing the solubility of Cuprous Chloride in Hydrochloric Acid solutions from 0° to 100°. The results are not in good agreement with those of Engel, 1889 [Note: In the report of Engel's data, Vol. I, p. 477, Top, Columns 5 and 7, giving the amount of HCl in 100 cc and 100 gms. of solution respectively, should be multiplied by 10. Thus a solution containing 0.448 gms. $CuCl_2$ also contained 3.12 gms. HCl, etc.] Engel's data show a decrease in solubility with increasing temperature, while the reverse is true in the present work.

Numerical results are given only for the composition of solutions saturated with both CuCl and HCl, and the other data listed below were read from the curves.

Gms. HCl per 100 gms. Sat. Sol.	Gms. CuCl per 100 gms. Saturated Solution				
	0°	25°	50°	80°	100°
5	1.5	1.5	2	4	5
10	4.5	6	7	10	13
15	8	12.5	14	18	22.5
19.27	-	-	-	-	30.0*
20	11	18.5	21	25	
23.25	-	-	-	29.43*	
25	14	23.5	26		
27.5	-	-	26.0*		
30	16.5	24.9*			
34.7	30.02*				

*Saturated with CuCl + HCl

THE SYSTEM CuCl + NH_4Cl + H_2O

(Morozov and Ustavshikova, 1944)

The authors present a diagram of the system at 0°, 25°, 50°, 80°, and 100°. Two compounds were identified: $2CuCl \cdot NH_4Cl$ (at 25°) and $CuCl \cdot NH_4Cl$ (at 50°).

The system CuCl + NH_4Cl + HCl + H_2O was studied at 50°, 80° and 100° by Morozov and Ustavshikova, 1944. Their data are presented in the form of 3 dimensional graphs. The compound $CuCl \cdot NH_4Cl$ exists at 50°. And the compositions of the invariant solutions are given for this temperature.

Ferry and Riley (1946) calculate the solubility of CuCl in sea water to be 0.0031 gms. per cc. at 25°. (using oxygen-free water).

SOLUBILITY OF CUPROUS CHLORIDE IN DIOXANE

(Heines and Yntema, 1988)

About 5 gms. CuCl were allowed to stand in contact with 25 cc of Anhydrous Dioxane at 26.5° for two weeks. After that time the solution contained 0.031 gms. CuCl per 100 ml. of saturated solution.

SOLUBILITY OF CUPROUS CHLORIDE IN ALLYL ALCOHOL SOLUTIONS AT 25°

(Keefer and Andrews, 1949)

HCl was added to adjust the $[Cl^-]$ concentration. $HClO_4$ was then used to make the ionic strength of the solvent = 0.10 $[H^+]$ = 0.10.

Alcohol Initial moles per liter	Cl^- Initial moles per liter	Cu^+ Total moles per liter	Alcohol Initial moles per liter	Cl^- Initial moles per liter	Cu^+ Total moles per liter
0.0809	0.0	0.0393	0.0202	0.00938	0.0117
.0400	0.0	.0226	.0101	.00938	.0065
.0300	0.0	.0175	.0400	.0938	.0196
.0200	0.0	.0128	.0300	.0938	.0160
.0101	0.0	.0072	.0200	.0938	.0125
.0809	0.00938	.0378	.0809	0.0	.0394*
.0404	.00938	.0207	.0202	0.0	.0131*

*$[H^+]$ = 0.010 N

Cl

SOLUBILITY OF CUPROUS CHLORIDE IN ALLYL ALCOHOL SOLUTIONS AT 25°

(Kepner and Andrews, 1948)

Column "C" represents the total amount of Cu^+ in each solution. Column "D" is the increase in the solubility due to the presence of the Allyl Alcohol in the solutions. (Value in "C" minus the solubility in the HCl solution of the same strength as column "B").

A	B	C	D
Moles Allyl Alcohol per liter of Solvent	Moles HCl per liter of Solvent	Total Moles Cu^+ per liter of Sat. Sol.	Moles Cu^+ due to Allyl Alcohol per liter of S.S.
*0.0	0.0	0.00238	-
.0145	0.0	.00778	0.00540
.0290	0.0	.0137	.0113
.0580	0.0	.0256	.0232
.0724	0.0	.0300	.0276
.1086	0.0	.0459	.0435
0.0	0.0094	.00098	-
.0132	.0094	.00782	.00684
.0264	.0094	.0125	.0115
.0527	.0094	.0246	.0236
.0658	.0094	.0298	.0288
.0986	.0094	.0438	.0428
0.0	.0094	.0022	-
.3969	.0094	.153	.151
.5954	.0094	.234	.232
.9923	.0094	.406	.404

*In solutions containing no HCl, the solid gradually turned red, indicating that hydrolysis had occurred.

SOLUBILITY OF CUPROUS CHLORIDE IN MIXTURES OF MALEIC, FUMARIC, SULFURIC AND PERCHLORIC ACID SOLUTIONS AT 25°

(Andrews and Keefer, 1948)

The data below represent the increase in the solubility of CuCl when the organic acid is added to the mixture, over the solubility in the absence of the organic acid.

Solubility in Mixtures of Sulfuric and Maleic Acids

Gm. mols. H_2SO_4 per liter	Gm. mols. Maleic Acid per liter	Gm. mols. Cu^+ per liter
1.19	0.151	0.0103
0.595	.152	.0125
.477	.159	.0132
.477	.0794	.0069
.477	.0397	.0034
.298	.151	.0135
.119	.151	.0152
.0595	.150	.0163

Solubility in Mixtures of Perchloric and Maleic Acids

Gm. mols. $HClO_4$ per liter	Gm. mols. Maleic Acid per liter	Gm. mols. Cu^+ per liter
0.903	0.146	0.0107
.602	.146	.0115
.421	.146	.0125
.301	.146	.0133
.120	.146	.0148
.0602	.146	.0166

Solubility in Mixtures of Sulfuric and Fumaric Acids

Gm. mols. H_2SO_4 per liter Sat. Sol.	Gm. mols. Fumaric Acid per liter Sat. Sol.	Gm. mols. Cu^+ per liter Sat. Sol.
0.477	0.0350	0.0093
.477	.0456	.0107
.477	.0342	.0091
.477	.0504	.0116
.238	.0456	.0100
.094	.0456	.0112
.0496	.0504	.0111
.0496	.0452	.0115
.0496	.0378	.0093
.0496	.0339	.0087
0.0	.0452	.0103
0.0	.0438	.0103

SOLUBILITY OF CUPROUS CHLORIDE IN MALEIC ACID SOLUTIONS AT 25°

(Andrews and Keefer, 1949)

With HCl Added Moles per liter of Sat. Sol.			
Maleic Acid	KCl	H^+	Total Cu^+
0.202	0.0	1.03[x]	11.8
.101	0.0	1.02[x]	7.7
.0503	0.0	1.02[x]	4.8
.202	0.100	1.03[x]	11.0
.101	.100	1.02[x]	8.0
.0503	.100	1.02[x]	6.8
.184	.0091	1.03[x]	9.2
.101	.0100	1.02[x]	5.3
.0503	.0100	1.02[x]	3.0
.202	0.0	0.138[+]	19.2
.152	0.0	.129[+]	16.0
.101	0.0	.122[+]	12.8
.0505	0.0	.113[+]	8.3
.202	0.100	.133[+]	14.2
.152	.100	.126[+]	12.4
.101	.100	.118[+]	10.9
.202	.0100	.136[+]	15.8
.101	.0100	.120[+]	9.6

With KCl Added Moles per liter of Sat. Sol.			
Maleic Acid	KCl	H^+	Total Cu^+
0.202	0.0	0.067[a]	24.0
.101	0.0	.043[a]	17.0
.0504	0.0	.028[a]	11.8
.202	0.100	.060[a]	17.6
.152	.100	.051[a]	15.4
.101	.100	.040[a]	12.8
.202	.010	.062[a]	20.2
.152	.010	.053[a]	17.3
.101	.010	.043[a]	14.1

x Adjusted to μ = 1.0 by addition of $HClO_4$ before addition of Maleic Acid and CuCl.

+ Adjusted to μ = 0.10 by addition of $HClO_4$ before addition of Maleic Acid and CuCl.

a) Adjusted to μ = 0.100 by addition of $NaClO_4$ before addition of Maleic Acid and CuCl.

SOLUBILITY OF CUPROUS CHLORIDE IN AQUEOUS SOLUTIONS OF UNSATURATED ACIDS AT 25°

(Keefer, Andrews, and Kepner, 1949a)

The $[Cl^-]$ concentration was varied by the addition of HCl. The ionic strength was adjusted in each case to $\mu = 0.100$ by addition of $HClO_4$.

Unsat. Acid moles per liter	$[Cl^-]$ moles per liter	Total Cu^+ moles per liter x 10^3
Crotonic Acid		
0.401	0.0	17.2
.316	0.0	15.2
.238	0.0	13.1
.158	0.0	9.7
.356	0.0938	13.0
.267	.0938	11.3
.178	.0938	9.6
Itaconic Acid		
0.202	0.0	15.0
.101	0.0	9.9
.0504	0.0	6.1
.202	0.100	13.0
.151	.100	11.5
.101	.100	9.8
.202	.010	11.8
.101	.010	7.4
Tiglic Acid		
0.094	0.0	3.1
.082	0.0	2.6
.094	0.100	7.0
.082	.100	6.7
.094	.010	2.2
B, B-Dimethyl Acrylic Acid		
0.136	0.0	2.9
.136	0.100	7.1
.136	.100	7.0
.136	.010	2.0
Fumaric Acid		
0.0465	0.0	11.6
.0399	0.0	9.7
.0232	0.0	7.2
.0465	0.0938	10.3
.0399	.0938	9.0
.0234	.0938	8.0
.0363	.0100	7.6
.0272	.0100	6.0
.0182	.0100	4.7
Vinyl Acetic Acid		
0.0930	0.0	35.0
.0465	0.0	20.5
.0233	0.0	12.3
.0116	0.0	7.4
.0930	0.100	28.8
.0465	.100	17.5
.0930	.010	32.1
.0233	.010	10.4
Mesaconic Acid		
0.151	0.0	4.5
.113	0.0	4.1
.076	0.0	3.0
.151	0.094	6.8
.113	.094	6.6
Citraconic Acid		
0.345	0.0	2.8
.459	0.100	8.1

Cl

8% Cuprous chloride by weight disolves in acetonitrile at 25°. (Pleskov, 1948)

SOLUBILITY OF CUPROUS CHLORIDE IN AQUEOUS SOLUTIONS OF UNSATURATED ALCOHOLS AT 25°

(Keefer, Andrews, and Kepner, 1949)

The $[Cl^-]$ concentration was varied by the addition of HCl. The ionic strength was adjusted in each case $\mu = 0.100$ by addition of $HClO_4$.

Moles Unsat. Alcohol per liter	Moles Cu^+ per liter x 10^3 (Cl^-=0)	(Cl^-=0.100)	(Cl^-=0.010)
Ethyl Vinyl Carbinol			
0.0929	35.6	30.5	34.2
.0464	21.7	18.4	19.6
.0232	12.8	12.3	
.0116	8.1		
α,α - Dimethyl Allyl Alcohol			
0.0910	31.1	25.3	
.0682	25.2	20.5	22.5
.0455	18.5	15.8	16.5
.0228	10.9		
3 - Methyl - 3 - Buten - 2 - ol			
0.0504	9.1	10.0	6.8
.0378	7.7	9.0	5.5
2 - Methyl - 2 - Buten - 1 - ol			
0.0189	4.9	8.0	3.5
β - Methallyl Alcohol		(a)	(b)
0.0708	17.8	15.8	15.0
.0472	13.2	12.1	10.8
.0236	8.1	9.6	

Moles Unsat. Alcohol per liter	Moles Cu^+ per liter x 10^3 (Cl^-=0)	(Cl^-=0.100)	(Cl^-=0.010)
Methyl Vinyl Carbinol			
0.0728	30.6	25.8	
.0546	24.6	21.1	
.0364	18.0	16.0	16.2
.0182	10.3		
4 - Methyl - 4 - Penten - 2 - ol			
0.0336	12.8	11.6	10.3
.0168	7.6	9.0	6.1
.0884	4.3		
γ,γ - Dimethyl Allyl Alcohol			
0.0328	10.7	10.2	7.9
.0164		8.1	5.5
β - Chloro Allyl Alcohol			
.500	8.2	9.5	5.8
Crotyl Alcohol		(c)	(d)
0.142	26.8	22.0	23.7
.106		17.4	18.7
.0708		13.9	
.0688	16.6		
.0342	10.2		

a, b, c, d: Cl^- = 0.101, 0.0101, 0.102, 0.0102

COPPER (ic) CHLORIDE $CuCl_2$

Cl

SOLUBILITY IN HYDROCHLORIC ACID SOLUTIONS AT 80°

(Morozov and Ustavshikova, 1945)

The following data were read from the curve presented by the authors:

Gms. HCl per 100 gms. Sat. Sol.:	5	10	15
Gms. $CuCl_2$ per 100 gms. Sat. Sol.:	44	38	35

SOLUBILITY IN AQUEOUS AMMONIA AT 20°

(Archipov and Paksver, 1939)

A 21% NH_3 solution of $CuCl_2$ contains 142.0 gms. Cu per liter.

THE SYSTEM $CuCl_2 + NH_4Cl + H_2O$ AT 80°
(Morozov and Ustavshikova, 1945)

The authors present a diagram of the system, and the following invariant solutions:

Gms. $CuCl_2$ per 100 gms. Sat. Sol.	Gms. NH_4Cl per 100 gms. Sat. Sol.	Solid Phases
7.06	37.64	$NH_4Cl + CuCl_2 \cdot 2NH_4Cl \cdot 2H_2O$
50.5	8.2	$CuCl_2 \cdot 2NH_4Cl \cdot 2H_2O + CuCl_2 \cdot 2H_2O$

The system $CuCl_2 + NH_4Cl + HCl + H_2O$ was studied by Morozov and Ustavshikova, 1945 at 25° and 80°, and their data is presented in the form of 3 dimensional graphs. The compositions of the invariant solutions are tabulated, and the compound $CuCl_2 \cdot 2NH_4Cl \cdot 2H_2O$ was found at both temperatures.

100 cc of a mixture of equal volumes of Diethyl Ether and Water, saturated with HCl at 0° will dissolve 6.4 gms. of $CuCl_2$. -Fischer and Seidel, 1941.

SOLUBILITY IN DIOXANE AT 26.5°

Heines and Yntema, 1938 found the solubility to be 0.311 gms. $CuCl_2$ per 100 cc of saturated solution by allowing Anhydrous Dioxane to stand in contact with the solid for two weeks. The authors found a 1:2 and a 2:1 compound to be formed between the substances.

Cl COPPER (ic) CHLORIDE Basic

$CuCl_2 \cdot 3CuO \cdot 4H_2O$ (Atacamite) was shaken with distilled water containing varying amounts of Carbon Dioxide at 20°.

Gms. Co_2 per liter:	0	0.38	0.90
Mg. Cu per liter:	0.8	50.3	91.0

(Archipov and Paksver, 1939)

The solubility product was determined by Nasanen (1942a)

The solubility product at 25° in Potassium Chloride Solutions was determined by Nasanen and Tamminen, 1949.

COPPER Choline CHLORIDE $(CH_3)_2NClC_2H_4OH \cdot CuCl_2$

0.1 gms. are dissolved in 100 ml. of solution in water at room temperature. (Seaman, Huganet, and Leibmann, 1949).

COPPER Tetrapyridine CHLORIDE (ous) $[Cu_2(C_5H_5N)_4]Cl_2$

SOLUBILITY IN WATER
(Marukhyan, 1940)

t°	25	30	35	40	45	50	55	60	65	70
Gms. $[Cu_2(C_5H_5N)_4]Cl_2$ per 100 ml. H_2O	0.2	0.25	0.3	0.31	0.315	0.317	0.33	0.35	0.38	0.39

COPPER Hexahydroxy PERCHLORATE (ic) ClO

The solubility product at 25° in Sodium Perchlorate Solutions was determined by Nasanen and Tamminen, 1949.

COPPER CHROMATE $CuCrO_4$ CrO

EQUILIBRIUM IN THE SYSTEM COPPER OXIDE - CHROMIC OXIDE - WATER AT 29.9°

(Campbell and Lemaire, 1947)

Five solid phases were found in the system. The normal Chromate $CuCrO_4$ is partially metastable with respect to the compound $CuCrO_4 \cdot Cu(OH)_2$, but the extent of the metastability was not determined.

Gms. CuO per 100 gms. Sat. Sol.	Gms. CrO_3 per 100 gms. Sat. Sol.	Solid Phase
0.0	64.8	CrO_3
1.0	64.4	"
5.7	62.1	"
10.9	60.6	"
12.6	61.0	"
13.2	61.8	$CuCr_2O_7 \cdot 2H_2O + CrO_3$
13.1	61.7	"
13.8	60.7	$CuCr_2O_7 \cdot 2H_2O$
14.6	58.6	"
15.0	54.7	"
14.5	53.1	$CuCrO_4$
15.1	47.4	"
15.4	46.9	$CuCrO_4$
15.0	40.5	"
12.7	31.9	"
10.1	25.4	"
8.80	22.3	"
7.94	19.6	"
6.60	16.6	"
5.80	14.8	"
4.31	11.3	"
6.80	10.5	$CuCrO_4 \cdot Cu(OH)_2$
5.70	8.53	"
4.74	7.32	$2CuCrO_4 \cdot 3Cu(OH)_2 \cdot H_2O$
2.42	5.89	"

COPPER IODIDE (ous) CuI I

THE SYSTEM COPPER - IODINE - BENZENE AT 6°

(Foote and Fleischer, 1940)

The results indicate that CuI is the only stable compound between Copper and Iodine above 6°.

Wt. % Iodine in Solution	Wt. % Iodine in Residue	Solid Phase
0.0	55.00	Cu + CuI
3.05	65.99	CuI
7.79	66.20	"
8.53	69.40	CuI + I_2
8.61	91.57	"

IO CUPRIC IODATE $Cu(IO_3)_2$

SOLUBILITY OF CUPRIC IODATE IN AQUEOUS SOLUTIONS AT 25°
(Keefer, 1948)

In Potassium Chloride Solutions		In Glycine Solutions		
Moles per 1000 gms. H_2O		Moles per 1000 gms. H_2O		pH
KCl	$Cu(IO_3)_2$	Glycine	$Cu(IO_3)_2$	
0.0	0.003245	0.01253	0.004096	3.32
.00501	.003398	.02509	.004805	3.31
.01002	.003517	.05023	.00617	3.35
.02005	.003730	.07542	.00746	3.37
.03511	.003975	.1008	.00872	3.38
.05017	.004166	.1515	.01116	3.39
.07529	.004453	.2025	.01352	3.41
.1005	.004694			

In Alanine Solutions		
Moles per 1000 gms. H_2O		pH
Alanine	$Cu(IO_3)_2$	
0.01252	0.00398	3.40
.02508	.00460	3.37
.05019	.00584	3.40
.07541	.00698	3.43
.1008	.00806	3.44
.1516	.01022	3.47
.2027	.01230	3.49

NO COPPER NITRATE (ic) $Cu(NO_3)_2$

100 gms. of a saturated solution in furfural contains 0.03 gms. of $Cu(NO_3)_2$ at 25°. Trimble (1941).

NO COPPER Trihydroxy NITRATE (ic)

The solubility product at 25° in Potassium Nitrate Solutions was determined by Nasanen and Tamminen, 1949.

O COPPER OXIDE (ous) Cu_2O

SOLUBILITY IN WATER CONTAINING CARBON DIOXIDE AT 20°
(Tronstad and Veimo, 1940)

Gms. CO_2 per liter	Mg. Cu_2O per liter
0.0	0.1
.31	5.4
.60	6.4

0.0000054 gms. of Cu_2O dissolve in one cc. of oxygen free sea water at pH = 8.1 at 25°. (Ferry and Riley, 1946).

The reactions occurring at 700° between Cu_2O + MnS and Cu_2O + Cu_2S were studied by Schenck and Keuth, 1940.

COPPER OXIDE (ic) CuO

O

SOLUBILITY IN WATER CONTAINING CARBON DIOXIDE AT 20°
(Tronstad and Veimo, 1940)

Gms. CO_2 per liter	Mg. CuO per liter
0.0	0.15
.07	8.5
.20	22.7
.32	44.2

A solution of CuO in 21.75% aqueous NH_3 at 20° contains 2.46 gms. Cu per liter. Archipov and Paksver, 1939.

One cc. of sea water 1×10^{-9} gms. CuO at pH 8.1, at 25°. Ferry and Riley, 1946.

The following systems have been studied:

CuO + Fe_2O_3	Milligan and Holmes (1941)
CuO + NiO	Rigamonti (1947)
CuO + MgO	" "
CuO + ZnO	" "

COPPER HYDROXIDE (ic) $Cu(OH)_2$

OH

Recent determinations of the solubility product:

5×10^{-19} between 20° and 30° (Geloso and Deschamps, 1947)
3.9×10^{-19} (Nasanen, 1942a).
2.2×10^{-20} (Thermodynamic solubility product)(Nasanen and Tamminen, 1949).

Oka, 1940 found the solubility to be 5.4×10^{-7} moles per liter.

SOLUBILITY OF $Cu(OH)_2$ IN AMMONIA SOLUTIONS AT 20°
(Archipov and Paksver, 1939)

% NH_3	Gms. Cu per liter
13.15	8.40
21.75	13.75
26.3	8.92 (18.92?)

1.3×10^{-8} gms. of $Cu(OH)_2$ are dissolved in 1 cc. of sea water of pH 8.1 at 25°. Ferry and Riley, 1946.

EQUILIBRIUM IN THE SYSTEM $Cu(OH)_2 - CuSeO_4 - H_2O$ AT 30°

(Baroni, 1942)

Saturated Solution: Moles CuO per mole SeO_3	Saturated Solution: Moles H_2O per mole SeO_3	Solid Phase	Saturated Solution: Moles CuO per mole SeO_3	Saturated Solution: Moles H_2O per mole SeO_3	Solid Phase
0.950	50.0	$4CuO \cdot SeO_3 \cdot H_2O$	.970	300.0	$4CuO \cdot SeO_3 \cdot H_2O$
.952	90.0	"	.975	315.0	"
.971	175.0	"	.960	500.0	"
.960	240.0	"	.950	700.0	"

OH

SOLUBILITY OF COPPER HYDROXIDE IN AMMONIA SOLUTIONS AT 18° - 20°

(Arkulov, 1948)

30 gms. $Cu(OH)_2$ were taken for each determination; Stirred 18 hours.

Gms. Added Substance per liter		Gms. Cu per liter: Gms. NH_3 per liter 50	100	200
Pyridine	0.0	3.75	7.87	
	10.0	3.62	7.38	
	25.0	3.37	7.12	
	50.0	2.95	6.50	
Urea	3.0	3.75	7.90	
Aniline	0.0			9.73
	5.1			9.65
	16.2			9.65
	20.4			9.12

The author also givesdata for the variation in the solubility of Copper Hydroxide in ammonia alone, with time of stirring, amount of sample taken, and amount of ammonia added. Other data are given for the addition of NH_4CNS, $(NH_4)_2CO_3$, $(NH_4)_2SO_4$ and NaOH.

EQUILIBRIUM IN THE SYSTEM $CuO + CuSO_4 + H_2O$ AT 18°

(Gromov, 1948)

$CuSO_4$ Wt. %	Gms. Cu per liter	Density	pH	Solid Phase
17.4	82.8	1.196	3.80	$3CuO \cdot CuSO_4 \cdot xH_2O + CuSO_4 \cdot 5H_2O$
8.8	39.1	1.119	4.07	$3CuO \cdot CuSO_4 \cdot xH_2O$
5.87	24.8	1.060	4.17	"
4.29	17.4	1.038	4.22	"
1.55	6.2	1.014	4.31	"
0.68	2.7	1.007	4.41	"
.40	1.6	1.004	4.45	"
.19	0.72	1.002	4.96	"
.14	.55	1.001	5.04	"
.10	.38	1.001	5.24	"
.025	.10	1.000	5.80	"
0.0	0.0	1.000	6.2	Not determined

EQUILIBRIUM IN THE SYSTEM $CuO + CuSO_4 + ZnO + ZnSO_4 + H_2O$ AT 18° OH
(Gromov, 1948)

Gms. Zn per liter	Gms. Cu per liter	pH	Solid Phase
185.3	0.38	5.30	$3ZnO \cdot ZnSO_4 \cdot xH_2O + 3CuO \cdot CuSO_4 \cdot xH_2O$
144.5	.28	5.44	"
108.5	.17	5.55	"
70.5	.12	5.70	"
53.0	.083	5.80	"
30.3	.045	6.05	"
16.6	Slight	6.18	"
9.4	-	6.31	"

COPPER Tetrapyridine PERRHENATE $[Cu(C_5H_5N)_4](ReO_4)_2$ ReO

At 20°, the solubility is 5.555 gms. per liter. Druce, 1948.

COPPER SULFIDE (ous) (ic) Cu_2S, CuS S

Kapustinsky (1940) calculated the solubility products of Cu_2S and CuS from thermochemical data and obtained the values:

$$KCu_2S = 2.6 \times 10^{-49}$$
$$KCuS = 3.2 \times 10^{-38}$$

which are in good agreement with previously determined values (Vol. I, p. 498).

The system Cu_2S + CuS has been studied by Buerger (1939, 1941) and Ramdohr (1943).

COPPER SULFATE $CuSO_4$ SO

A solution of $CuSO_4$ in 13.15% NH_3 contains 66.5 gms. Cu per liter at 20°. - Archipov and Paksver, 1939.

- 0.080 gms. $CuSO_4$ are dissolved in 100 gms. of a saturated solution in 50% alcohol.

- 0.0091 gms. $CuSO_4$ are dissolved in 100 gms. of a saturated solution in 50% alcohol, saturated with benzene. Grinberg and Zemlyakova, 1948.

Basic COPPER SULFATE $CuSO_4 \cdot 5Cu(OH)_2$ SO

SOLUBILITY OF $5Cu(OH)_2 \cdot CuSO_4$ IN AQUEOUS AMMONIA SOLUTIONS AT 20°
(Archipov and Paksver, 1939)

10 gms. of the basic salt $5Cu(OH)_2 \cdot CuSO_4$ were shaken with 100 ml. of an 18% NH_3 solution which contained 0.5 grams of each of the following solutes:

Added Solute	Gms. Cu per liter	Added Solute	Gms. Cu per liter
None	32.6	Na_2SO_4	34.67
Glucose	39.6	Tartaric Acid	43.0
NH_4Cl	38.06	Pyridine	29.43
NaCl	34.4	Cu_2Cl_2	36.2

The authors shook 10 gms. of $5Cu(OH)_2 \cdot CuSO_4$ with varying amounts of an 18% NH_3 solution, and determined the concentration of the copper in each solution:

Ml. 18% NH_3 Added to 10 gms. of Basic Salt	Gms. Cu per liter
100	30.22
167	24.70
200	23.20
500	12.10

SO COPPER Trihydroxy SULFATE (ic) $CuSO_4 \cdot 3Cu(OH)_2$

The solubility product at 25° in Potassium Sulfate Solutions was determined by Nasanen and Tamminen, 1949, and Nasanen, 1942a.

COPPER POTASSIUM SULFATE $CuSO_4 \cdot K_2SO_4 \cdot 6H_2O$

Hill, Durham, and Ricci, found the solubility at 25° to be 10.35 gms. $CuSO_4 \cdot K_2SO_4$ per 100 gms. of saturated solution (d = 1.094, Molarity - 0.3392). (1940)

THE SYSTEMS COPPER POTASSIUM SULFATE - COPPER AMMONIUM SULFATE - WATER COPPER POTASSIUM SULFATE - NICKEL POTASSIUM SULFATE - WATER, AND COPPER POTASSIUM SULFATE - ZINC AMMONIUM SULFATE - WATER AT 25°

(Hill, Durham, and Ricci, 1940)

Each point was determined in duplicate, reversing the order of addition of the salts, in order to assure the attainment of equilibrium. Continuous solid solutions containing six molecules of water were formed in each case.

$$CuK_2(SO_4)_2 + Cu(NH_4)_2(SO_4)_2$$

Saturated Solution		Solid Phase	
Wt. % $CuK_2(SO_4)_2$	Wt. % $Cu(NH_4)_2(SO_4)_2$	Wt. % $CuK_2(SO_4)_2$	Wt. % $Cu(NH_4)_2(SO_4)_2$
0.0	18.60	-	-
2.03	15.44	16.35	57.01
3.28	13.49	26.90	46.92
5.45	10.04	42.78	31.62
6.87	7.35	54.31	20.60
8.55	3.90	66.12	9.01
10.35	0.0	-	-

$CuK_2(SO_4)_2 + NiK_2(SO_4)_2$

Saturated Solution		Solid Phase	
Wt. % $CuK_2(SO_4)_2$	Wt. % $NiK_2(SO_4)_2$	Wt. % $CuK_2(SO_4)_2$	Wt. % $NiK_2(SO_4)_2$
10.35	0.0	-	-
9.26	0.71	61.77	13.86
7.84	1.507	44.91	30.51
6.56	2.220	33.11	42.26
5.07	3.082	22.24	53.20
2.981	4.34	10.81	64.49
0.0	6.33	-	-

$CuK_2(SO_4)_2 + ZnK_2(SO_4)_2$

Wt. % $CuK_2(SO_4)_2$	Wt. % $ZnK_2(SO_4)_2$	Wt. % $CuK_2(SO_4)_2$	Wt. % $ZnK_2(SO_4)_2$
0.0	11.72	-	-
1.303	10.37	9.61	66.17
3.010	8.53	22.68	52.87
4.74	6.64	36.30	39.25
6.42	4.74	49.44	26.08
8.22	2.617	62.81	12.68
10.35	0.0	-	-

COPPER AMMONIUM SULFATE $CuSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ SO

Hill, Durham, and Ricci (1940) found the solubility to be 18.60 gms. $CuSO_4 \cdot (NH_4)_2SO_4$ per 100 gms. of saturated solution at 25° (d = 1.160, Molarity = 0.7399).

THE SYSTEM COPPER AMMONIUM SULFATE - MAGNESIUM AMMONIUM SULFATE - WATER AT 25°

(Hill, Durham, and Ricci, 1940)

Each determination was done in duplicate, and the order of addition of the salts was reversed, in order to assure the attainment of equilibrium.

Saturated Solution		Solid Phase	
Wt. % $Cu(NH_4)_2SO_4$	Wt. % $Mg(NH_4)_2SO_4$	Wt. % $Cu(NH_4)_2SO_4$	Wt. % $Mg(NH_4)_2SO_4$
0.0	16.61	-	-
3.46	13.73	14.88	55.82
6.47	11.14	28.67	42.54
8.65	9.16	38.53	33.16
12.44	5.76	53.94	18.29
15.88	2.63	65.25	6.81
18.60	0.0	-	-

SeO COPPER SELENATE $CuSeO_4$

SOLUBILITY IN WATER
(Klein, 1940)

t°	Density	Gms. $CuSeO_4$ per 100 gms. Sat. Sol.	Gms. $CuSeO_4$ per 100 gms. H_2O	Solid Phase
-0.5	1.0646	6.13	6.53	Ice
-1.0	-	-	-	Ice + $CuSeO_4 \cdot 5H_2O$
0.0	1.1206	10.44	11.65	$CuSeO_4 \cdot 5H_2O$
21.2	1.1654	14.73	17.27	"
40.2	1.2235	19.72	24.56	"
54	1.2827	24.27	32.04	"
60.2	1.3128	26.74	36.50	"
70	1.3660	30.40	43.6	"
80	1.4318	34.93	53.68	"

Considerably higher results than the above were obtained by Metzner (1898). Klein's results, however, are in agreement with the work of MacAlpine and Sayre (Vol. I, p. 518).

THE SYSTEM COPPER SELENATE - AMMONIUM SELENATE - WATER AT 25°
(King and Beckman, 1945)

Gms. $(NH_4)_2SeO_4$ per 100 gms. Sat. Sol.	Gms. $CuSeO_4$ per 100 gms. Sat. Sol.	Solid Phase
0.0	16.09	$CuSeO_4 \cdot 5H_2O$
4.89	15.91	"
6.88	15.98	"
9.42	16.06	$CuSeO_4$ + 1:1:6
9.82	15.61	1:1:6
*10.96	12.30	"
14.67	7.02	"
18.66	4.47	"
18.70	4.47	"
21.40	3.31	"
21.60	3.17	"
25.47	2.20	"
35.25	0.49	"
40.29	.23	"
42.71	.19	"
50.20	Trace	"
53.84	"	1:1:6 + $(NH_4)_2SeO_4$
54.02	0.0	$(NH_4)_2SeO_4$

1:1:6 = $CuSeO_4 \cdot (NH_4)_2SeO_4 \cdot 6H_2O$

*The solubility of Copper Ammonium Selenate (1:1:6) is 23.26 gms. $CuSeO_4 \cdot (NH_4)_2SeO_4$ per 100 gms. saturated solution.

NO ERBIUM NITRATE $Er(NO_3)_3$

100 ml. of a saturated solution of erbium nitrate in ether at 20° contain 190 mg. Er_2O_3. (Wells, 1930).

IRON Fe

The following systems have been studied:

$Fe + NiO \rightleftharpoons FeO + Ni$	(1560°, 1790°)	Jander and Serf (1933).
$Fe + MnO \rightleftharpoons FeO + Mn$	(1560°)	Krings and Schackmann (1931)
	(1540°)	Herasymanko (1938)
$Fe + PbS \rightleftharpoons FeS + Pb$	--	Urazov, Borobev, and Ainbinder (1936)
$Fe + NiSiO_3 \rightleftharpoons FeSiO_3 + Ni$	(1480°)	Strassen (1931)
$2Fe + SiO_2 \rightleftharpoons 2FeO + Si$	(1640°)	Herasymanko (1938)

FERRIC ARSENATE $FeAsO_4$ AsO

Scorodite ($FeAsO_4 \cdot 2\frac{1}{2}H_2O$) was found to decompose completely in NaOH solutions when the molar ratio of As_2O_5:NaOH equalled 1:6. Solutions in which the As_2O_5:NaOH ratio exceeded 1:4 contained practically pure Na_3AsO_4, and there was no iron nor Na_2HAsO_4 in the solution. Viehherz and Krachevskaia, 1936.

FERROUS PYRIDINE RHODINATE $C_5H_5NFeCNS$? CNS

0.0136 mols are dissolved in one liter of a saturated solution in water. 0.0202 moles are dissolved in one liter of a saturated solution in Absolute Alcohol (probably at 20°) Treadwell and Ammann, 1938.

FERROUS ANTHRANILATE $Fe(H_2NC_6H_4COO)_2$

0.0124 mols. are dissolved in one liter of a saturated solution which is 1N with Acetic Acid (probably at 20°) Treadwell and Ammann, 1938.

FERRIC CUPFERRATE $Fe(C_6H_5N(NO)O)_3$ CH

The solubility product was found to be 9.9×10^{-26} by Pyatnitski, 1946.

FERROUS OXYQUINOLATE $Fe(C_9H_6ON)_2 \cdot 2H_2O$

0.00590 mols. are dissolved in one liter of a saturated solution which is 1N with Acetic Acid (probably at 20°) Treadwell and Ammann, 1938.

Cl FERROUS CHLORIDE $FeCl_2$

The SOLUBILITY OF FERROUS CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 20°

(Schafer, 1949)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
HCl	$FeCl_2$			HCl	$FeCl_2$		
0.0	38.5	1.443	$FeCl_2 \cdot 4H_2O$	20.03	9.75	1.204	$FeCl_2 \cdot 4H_2O$
1.82	35.5	1.415	"	21.9	7.85	1.196	"
3.65	32.4	1.386	"	23.7	6.46	1.190	"
5.47	29.5	1.359	"	25.5	5.45	1.188	"
7.29	26.7	1.334	"	27.3	4.57	1.190	"
9.11	23.9	1.310	"	29.1	3.93	1.194	"
10.93	21.4	1.288	"	30.9	2.13	1.198	$FeCl_2 \cdot 4H_2O$ +
12.75	18.9	1.267	"				$FeCl_2 \cdot 2H_2O$
14.57	16.5	1.248	"	32.8	1.89	1.202	$FeCl_2 \cdot 2H_2O$
16.40	14.1	1.230	"	34.6	1.74	1.207	"
18.21	11.9	1.216	"	36.4	1.58	1.212	"

THE SYSTEM FERROUS CHLORIDE - AMMONIUM CHLORIDE - WATER AT 35°

(Lushnaya, 1949)

Gms. per 100 gms. Saturated Solution		% $FeCl_2$ in Mixed Crystals (Extrapolated)	Solid Phase
NH_4Cl	$FeCl_2$		
30.35	0.0	0.0	NH_4Cl
27.94	4.85	1.2	α - Solid Solution
24.55	9.50	3.5	"
24.98	8.51	4.0	"
22.08	12.53	6.0	"
20.18	15.18	9.9	"
19.47	16.98	12.5	"
18.45	19.01	15.8	"
16.84	22.17	20.2	"
15.99	23.04	21.0	"
15.20	24.19	24.5	"
15.07	24.74	27.2	"
15.23	25.21	28.4	"
13.25	26.84	34.8	β - Solid Solution
11.36	29.38	38.5	"
9.72	30.87	43.3	"
8.68	32.04	48.3	"
6.72	35.55	50.8	"
5.49	38.47	52.5	"
4.96	39.62	61.5	β - Solid Solution + $FeCl_2 \cdot 4H_2O$
2.50	38.90	63.75	$FeCl_2 \cdot 4H_2O$
0.0	40.20	-	

FERRIC CHLORIDE $FeCl_3$

COMPOSITIONS OF SOLUTIONS IN EQUILIBRIUM WITH ICE IN THE SYSTEM $FeCl_3$ - HCl - H_2O

(Kurnakov and Nikitina, 1938)

t°	Mols. per 100 mols. $FeCl_3$ + HCl + H_2O	
	$FeCl_3$	HCl
-25	0.0	7.81
	2.79	1.50
	2.82	3.38
	3.46	0.0
-20	0.0	6.14
	1.04	4.16
	2.29	1.10
	2.75	1.55
	2.99	0.0
-15	0.0	5.20
	0.76	3.44
	1.33	2.07
	2.42	0.0
-10	0.0	4.01
	0.51	2.89
	1.71	0.28
	1.93	0.0
- 5	0.0	2.42
	1.35	0.0

DISTRIBUTION OF FERRIC CHLORIDE BETWEEN AQUEOUS HYDROCHLORIC ACID AND DichlorDiethylETHER AT 25°

(Axelrod and Swift, 1940)

Moles HCl per liter in H_2O Phase		Moles Fe per liter in H_2O Phase	Distribution Ratio $\frac{\text{Fe-Ether}}{\text{Fe-}H_2O}$
Initial	Final	Initial	
3.45	3.42	0.00895	0.065
4.24	4.19	.00895	.187
4.31	4.26	.00895	.186
5.17	5.10	.00895	.81
6.03	5.93	.00895	3.64
6.90	6.77	.00895	17.8
7.75	7.58	.00895	-
2.99	2.97	.0720	0.013
4.00	3.95	.0720	.066
4.20	4.14	.0720	.071
4.00	4.93	.0720	.294
5.17	5.09	.0720	.374
5.99	5.88	.0720	1.32
7.00	6.84	.0720	7.74
7.99	7.80	.0720	29.8
9.00	8.75	.0720	51
9.99	9.65	.0720	132
3.45	3.40	.574	0.043
4.24	4.15	.574	.136
5.17	5.02	.574	.350
6.03	5.66	.574	1.06
6.90	6.64	.574	2.88
8.63	8.33	.574	19.4

DISTRIBUTION OF $FeCl_3$ BETWEEN AQUEOUS HYDROCHLORIC ACID SOLUTIONS AND ISOPROPYL ETHER AT 20°

(Nachtrieb and Fryxell, 1948)

5 ml. of HCl + $FeCl_3$ of known concentration were shaken with 5 ml. of Isopropyl Ether in a thermostat. Radioactive Iron was used, and the amount of Iron in each phase was determined by counting the emanations with a Geiger-Muller tube.

The concentrations are expressed in gm. mols. per liter of solution.

$$K = \frac{[Fe^{+++}] \text{ in Ether layer}}{[Fe^{+++}] \text{ ir Water layer}}$$

Cl

Initial Concentration		K	Initial Concentration		K
HCl	$FeCl_3$		HCl	$FeCl_3$	
3.0	0.00339	0.00234	5.0	0.02066	0.781
	.00865	.00252		.04370	2.621
	.02066	.00233		.1559	6.133
	.02066	.00253		.3862	12.41
	.06073	.00342	6.0	.0002258	4.367
	.06073	.00319		.0002258	3.653
	.2059	.00961		.001129	3.459
	.2059	.0084		.00564	4.538
	.5064	.1606		.00564	3.771
	.5064	.175		.00764	2.598
4.0	0.0002258	0.0468		.00764	4.258
	.001129	.0525		.01566	6.050
	.00564	.0347		.03569	15.18
	.02066	.0463		.1238	42.95
	.05171	.0670		.3061	81.69
	.2059	.4685	7.0	0.0002258	29.81
	.4663	1.878		.0004516	24.05
5.0	0.0002258	0.389		.001129	19.77
	.001129	.370		.00564	28.39
	.00564	.300		.01072	50.52
	.00564	.4585		.02567	128.7
	.00564	.475		.05572	191.9
	.00865	.588		.1058	279.0
				.2059	659

Results with Solutions Containing $AlCl_3$

Initial Concentration			K	Initial Concentration			K
HCl	$AlCl_3$	$FeCl_3$		HCl	$AlCl_3$	$FeCl_3$	
4.500	0.500	0.0	-		.480	.0200	7.16
	.499	.00100	2.00		.470	.0300	9.03
	.498	.00200	2.47		.450	.0500	11.4
	.497	.00300	2.41		.400	.1000	14.9
	.495	.00500	3.04		.300	.2000	17.2
	.490	.0100	3.45		.200	.3000	10.5
	.490	.0100	4.49		0.0	.500	3.92

Distribution ratios for iron in the system $FeCl_3 + NH_4Cl + H_2O$ at 0° were obtained by Ioffe and Nikitin, 1942 by precipitating the mixed crystals from solutions containing definite concentrations of iron.

The solubility of $FeCl_3$ in pure S_2Cl_2 and in SCl_2 at 20° - 30° is less than 1 mg. %, and at 60° - 100° is less than 2 mg. %. In a mixture of the two solvents the solubility is slightly greater than in either alone. - Ionescu and Piatkowski, 1939. Cl

100 grams of a saturated solution of $FeCl_3$ in Furfural at 25° contain 0.55 grams $FeCl_3$. - Trimble, 1941.

Melting points and vapor pressures are given for the system $FeCl_3$ + NaCl by Johnstone, Weingartner, and Winsche, 1942.

FERRIC FLUORIDE FeF_3 F

SOLUBILITY OF FERRIC FLUORIDE IN WATER
(Tananaev and Deichman, 1946)

100 grams of a saturated solution in water at 25° contain 5.59 gms. FeF_3. The saturating solid phase is $FeF_3 \cdot 3H_2O$. This value does not agree with that of Carter (Vol. I, p. 533).

EQUILIBRIUM IN THE SYSTEM FERRIC FLUORIDE - HYDROGEN FLUORIDE - WATER AT 25°
(Tananaev and Deichman, 1946)

Silver Vessels were used

Gms. per 100 gms. Saturated Solution		Solid Phase	Gms. per 100 gms. Saturated Solution		Solid Phase
HF	FeF_3		HF	FeF_3	
0.0	5.59	$FeF_3 \cdot 3H_2O$	45.03	10.82	$FeF_3 \cdot 3H_2O$
1.14	5.01	"	45.21	14.95	"
1.70	5.58	"	45.35	12.07	"
3.16	6.16	"	45.50	14.52	"
6.24	5.54	"	46.00	16.73	$FeF_3 \cdot 3H_2O$ + $FeF_3 \cdot 3HF \cdot 3H_2O$
9.94	5.31	"	46.65	16.50	$FeF_3 \cdot 3HF \cdot 3H_2O$
13.26	4.70	"	47.62	12.97	"
15.71	4.43	"	49.90	9.90	"
18.26	4.19	"	50.12	10.67	"
21.40	3.76	"	52.69	8.22	"
26.94	3.71	"	54.15	7.53	"
33.53	3.91	"	55.60	5.70	"
43.81	9.44	"	61.23	3.22	"
44.60	9.56	"	64.37	3.13	"
44.59	10.81	"	70.98	1.06	"
44.72	10.96	"			

EQUILIBRIUM IN THE SYSTEM FERRIC FLUORIDE - POTASSIUM FLUORIDE - WATER AT 25°
(Tananaev and Deichman, 1946a)

Gms. per 100 gms. Saturated Solution		Solid Phase	Gms. per 100 gms. Saturated Solution		Solid Phase
KF	FeF_3		KF	FeF_3	
0.52	2.30	$FeF_3 \cdot 3H_2O$ + $2KF \cdot FeF_3 \cdot H_2O$	3.71	.002	$11KF \cdot 4FeF_3 \cdot 12H_2O$
			3.97	.001	"
.56	1.01	$2KF \cdot FeF_3 \cdot H_2O$	4.00	.001	"
.62	0.24	"	4.86	-	"
1.37	.03	"	7.17	-	"
1.57	.02	"	8.94	-	"
2.40	.006	$11KF \cdot 4FeF_3 \cdot 12H_2O$	13.34	-	$3KF \cdot FeF_3 \cdot 3H_2O$
2.89	.005	"	19.80	-	"
3.19	.002	"	22.80	-	"
3.31	.002	"	24.07	-	"
3.55	.002	"	31.75	-	"
3.66	.002	"	33.40	-	"

EQUILIBRIUM IN THE SYSTEM FERRIC FLUORIDE - SODIUM FLUORIDE - WATER AT 25°
(Tananaev and Deichman, 1945)

Gms. FeF_3 per 100 gms. Saturated Solution	Gms. NaF per 100 gms. Saturated Solution	Solid Phase
5.59	0.0	$FeF_3 \cdot 3H_2O$
7.32	0.15	$FeF_3 \cdot 3H_2O$ + $2FeF_3 \cdot 5NaF$
0.012	0.23	$2FeF_3 \cdot 5NaF$
Approx. 0	>0.7	"

F FERRIC Potassium FLUORIDE $FeF_3 \cdot 2KF \cdot H_2O$

The compound is congruently soluble. At 25°, one liter of a saturated solution in water contains 0.018 moles of compound. (Tananaev and Deichman, 1946a).

I FERROUS IODIDE FeI_2

THE SYSTEMS IRON - IODINE - BENZENE AND IRON - IODINE - TOLUENE AT 25°
(Foote and Fleischer, 1940)

The results indicate the non-existence of the compound FeI_3 at 6° or above.

Fe + I + Toluene

Gms. I_2 per 100 gms. Sat. Sol.	Solid Phase
0.0	Fe + FeI_2
1.31	FeI_2
10.06	"
10.46	FeI_2 + I_2
10.30	"

Fe + I + Benzene

Gms. I_2 per 100 gms. Sat. Sol.	Solid Phase
1.11	FeI_2
6.98	"
8.81	FeI_2 + I_2

NO

FERRIC NITRATE $Fe(NO_3)_3 \cdot 6H_2O$

100 grams of a saturated solution of $Fe(NO_3)_3 \cdot 6H_2O$ in furfural at 25° contain 0.21 grams of $Fe(NO_3)_3 \cdot 6H_2O$. - Trimble, 1941.

O

FERRIC OXIDE Fe_2O_3

The reaction $Fe_2O_3 + 6HCl \rightleftharpoons 2FeCl_3 + 3H_2O$ from 300° to 1000° was investigated by Schafer, 1949a.

The system Fe_2O_3 + NiO was studied above 1000° by Toropov and Borisenko, 1948.

CH

FERROUS HYDROXIDE $Fe(OH)_2$

Oka, 1940 found the solubility of Ferrous Hydroxide to be 1.3×10^{-5} moles per liter.

OH

FERRIC HYDROXIDE $Fe(OH)_3$

Oka, 1940 found the solubility of Ferric Hydroxide to be 3.4×10^{-10} moles per liter.

Freshly precipitated Ferric Hydroxide was found to be more soluble than a product which had aged for some time. Evans and Pryor (1949) found the solubility product of the freshly precipitated material to be 3.2×10^{-36} at 20°.

PO

FERRIC PHOSPHATE $FePO_4$
FERRIC PHOSPHATE (Basic)

Ghani and Aleem (1949) shook 10 mg. of each iron phosphate with 0.5 N Acetic Acid, 0.25 N NaOH, and 2 N H_2SO_4 for 2 hours at room temperature and report the mg. of P_2O_5 dissolved in the volume of each solvent used. These figures were calculated to more convenient form below.

Solvent	$FePO_4$ (Normal)	$[FePO_4 \cdot 5Fe(OH)_3]$? (Basic)
	Mg. P_2O_5 per 100 ml. Solvent	
0.5 N Acetic Acid	0.12	0.095
0.25 N NaOH	0.8	0.32
2 N H_2SO_4	1.56	0.80

Devyatin (1940) determined the solubility of $FePO_4$ in H_2O, .2 N and 1.0 N K_2CO_3 solutions both cold, and at the boiling point.

The solubilities of various phosphates in the soil under varying conditions of treatment were studied by Fraps, 1911.

S FERROUS SULFIDE FeS

Kapustinsky (1940) calculated the solubility product of Ferrous Sulfide from thermodynamic data and obtained the value Ksp = 3.8×10^{-20}. The calculated solubility in solutions of varying pH are as follows:

pH	3	5	7	9	11
Moles FeS per liter	1.9×10^{-2}	1.9×10^{-2}	2.7×10^{-6}	1.9×10^{-7}	2×10^{-8}

Isakov (1939) studied the calcination of FeS_2 at 500° and 700° in atmospheres of N_2, H_2O, and Air and determined the solubility of the decomposition products in HCl solutions.

SO FERROUS SULFATE $FeSO_4$

SOLUBILITY OF FERROUS SULFATE IN SULFURIC ACID SOLUTIONS FROM -20° TO 90°

(50° to 90° Belopolskii and Shpunt, 1941; -20° to + 5° Belopolskii and Urusov, 1948; + 10° to 90° Belopolskii, Kolicheva, and Shpunt, 1948)

These authors have made an extensive investigation of the system $FeSO_4$-H_2SO_4-H_2O by both isothermal and polythermal methods. They present data obtained by (1) determination of the temperature of appearance or disappearance of the solid phase. (2) the addition of solid $FeSO_4 \cdot 7H_2O$ to solutions of constant % H_2SO_4, and (3) the usual isothermal solubility determinations. Density was determined for both saturated and unsaturated solutions. In general the results agree rather well with those of Cameron (Vol. I, p. 540).

t°	Gms. H_2SO_4 per 100 gms. Sat. Sol.	Gms. $FeSO_4$ per 100 gms. Sat. Sol.	Density	Solid Phase
-20	23.30	0.0	-	Ice
	22.40	1.58	-	Ice + $FeSO_4 \cdot 7H_2O$
	23.26	1.35	-	$FeSO_4 \cdot 7H_2O$
-15	20.28	0.0	-	Ice
	18.37	3.53	-	Ice + $FeSO_4 \cdot 7H_2O$
	22.85	2.27	-	$FeSO_4 \cdot 7H_2O$
-10	16.30	0.0	-	Ice
	15.48	1.95	-	"
	13.34	6.03	1.161	Ice + $FeSO_4 \cdot 7H_2O$
	14.30	5.72	1.164	$FeSO_4 \cdot 7H_2O$
	17.34	4.77	1.177	"
	22.44	3.19	1.198	"
	25.0	2.4	1.209	"
-5	10.37	0.0	-	Ice
	9.32	2.20	-	"
	6.45	9.85	1.156	Ice + $FeSO_4 \cdot 7H_2O$
	8.10	9.05	1.160	$FeSO_4 \cdot 7H_2O$
	12.51	7.44	1.173	"
	13.94	6.94	1.179	"
	16.98	5.80	1.193	"
	22.04	4.12	1.213	"
	25.0	3.0	1.225	"

t°	Gms. H_2SO_4 per 100 gms. Sat. Sol.	Gms. $FeSO_4$ per 100 gms. Sat. Sol.	Density	Solid Phase
0	0.0	13.67	-	$FeSO_4 \cdot 7H_2O$
	1.41	13.30	1.159	"
	4.53	12.00	1.164	"
	7.84	10.50	1.173	"
	12.21	8.65	1.186	"
	13.57	8.17	1.191	"
	16.63	6.83	1.206	"
	21.63	5.04	1.226	"
	23.0	4.6	1.229	"
5	0.0	15.45	-	$FeSO_4 \cdot 7H_2O$
	1.35	14.75	-	"
	4.36	13.58	-	"
	7.59	11.92	-	"
	11.90	9.87	-	"
	15.21	9.38	-	"
	16.22	7.92	-	"
	21.22	6.10	-	"
10	0.0	17.12	-	$FeSO_4 \cdot 7H_2O$
	3.65	15.52	-	"
	7.46	13.58	-	"
	11.82	11.62	-	"
	16.60	9.42	-	"
	21.58	7.55	-	"
	26.55	6.25	-	"
15	0.0	19.10	-	$FeSO_4 \cdot 7H_2O$
	3.25	17.23	-	"
	3.48	17.25	-	"
	6.66	15.30	-	"
	7.20	15.28	-	"
	10.80	13.39	-	"
	11.32	13.38	-	"
	15.23	11.37	-	"
	15.90	11.28	-	"
	20.75	9.28	-	"
	25.78	7.65	-	"
20	0.0	20.90	-	$FeSO_4 \cdot 7H_2O$
	3.35	18.95	-	"
	6.92	17.05	-	"
	10.80	15.20	-	"
	15.20	13.25	-	"
	19.90	11.20	-	"
	24.75	9.50	-	"
25	0.0	22.98	-	$FeSO_4 \cdot 7H_2O$
	3.18	20.72	-	"
	3.81	20.68	1.253	"
	6.52	19.00	-	"
	7.26	18.53	1.257	"
	10.30	17.15	-	"
	11.93	16.60	1.265	"
	13.01	15.88	1.267	"
	14.50	15.20	-	"
	15.42	14.85	1.275	"
	19.00	13.20	-	"
	20.90	12.84	-	"
	23.55	11.72	1.294	"
	27.78	10.70	-	"

	t°	Gms. H_2SO_4 per 100 gms. Sat. Sol.	Gms. $FeSO_4$ per 100 gms. Sat. Sol.	Solid Phase
	30	0.0	24.70	$FeSO_4 \cdot 7H_2O$
		2.77	22.93	"
		2.98	22.60	"
		5.86	21.15	"
		6.20	21.02	"
		9.53	19.28	"
		9.70	19.25	"
		12.93	17.68	"
		13.65	17.48	"
		17.10	15.87	"
		18.00	15.55	"
		22.28	14.08	"
SO	35	0.0	26.58	$FeSO_4 \cdot 7H_2O$
		2.80	24.55	"
		2.70	24.92	"
		5.61	23.18	"
		5.83	22.95	"
		8.93	21.55	"
		9.15	21.35	"
		12.83	19.70	"
		14.73	18.98	"
		15.77	18.71	"
		16.85	18.00	"
		20.93	16.50	"
	40	0.0	28.70	$FeSO_4 \cdot 7H_2O$
		2.63	26.55	"
		5.45	24.92	"
		8.60	23.40	"
		11.95	22.06	"
		15.68	20.60	"
	45	0.0	30.85	$FeSO_4 \cdot 7H_2O$
		2.45	28.38	"
		5.10	26.90	"
		8.00	25.48	"
		11.15	24.30	"
	50	7.65	28.47	$FeSO_4 \cdot 7H_2O + FeSO_4 \cdot 4H_2O$
		8.62	27.60	$FeSO_4 \cdot 4H_2O + FeSO_4 \cdot H_2O$
		83.8	0.45	$FeSO_4 \cdot H_2O + FeSO_4$
	60	1.24	34.5	$FeSO_4 \cdot 4H_2O + FeSO_4 \cdot H_2O$
		84.5	0.5	$FeSO_4 \cdot H_2O + FeSO_4$
	70	85.9	0.54	$FeSO_4 \cdot H_2O + FeSO_4$
	90	84.13	0.82	$FeSO_4 \cdot H_2O + FeSO_4$

EQUILIBRIUM IN THE SYSTEM FERROUS SULFATE - FERROUS OXIDE - WATER AT 18°
(Gromov, 1948)

Gms. $FeSO_4$ per 100 gms. Sat. Sol.	Gms. Fe per liter	Density	pH	Solid Phase
19.0	88.0	1.259	6.46	$FeSO_4 \cdot 7H_2O + Fe_2O_3 \cdot 2FeO \cdot SO_3 \cdot xH_2O$
14.5	62.6	1.178	6.62	$Fe_2O_3 \cdot 2FeO \cdot SO_3 \cdot xH_2O$
9.1	36.8	1.103	6.79	"
8.5	34.5	1.100	6.80	"
4.3	16.5	1.046	6.94	"
1.55	5.8	1.015	7.14	"
0.30	1.1	1.004	8.50	

FERRIC SULFATE $Fe_2(SO_4)_3$ SO

EQUILIBRIUM IN THE SYSTEM FERRIC SULFATE - FERRIC OXIDE - WATER AT 18°
(Gromov, 1948)

Gms. H_2SO_4 per liter	Gms. Fe per liter	pH	Solid Phase
42.8	19.9	0.68	$3Fe_2O_3 \cdot 2SO_3 \cdot xH_2O$
26.0	11.3	0.98	"
24.3	10.4	1.01	"
22.4	9.7	1.05	"
18.3	8.7	1.14	"
14.6	6.1	1.24	"
10.0	4.3	1.40	"
8.0	3.2	1.49	"
3.3	1.14	1.88	"
1.9	0.40	2.12	"
0.25	0.07	2.59	"
Trace	Trace	4.14	$2Fe_2O_3 \cdot SO_3 \cdot xH_2O$

The solubility of $Fe_2(SO_4)_3$ in pure S_2Cl_2 and SCl_2 at 20° - 30° is less than 1 mg. %, and at 60° - 100°, less than 2 mg. %. In a mixture of the solvents the solubility is slightly greater than in either alone.
- Ionescu and Piatkowski, 1939.

GALLIUM Ga Ga

The solubility of Gallium in copper and silver was determined by Owen and Rowlands (1940) by means of X-Rays.

GALLIUM LACTATE $Ga(CH_3CHOHCOO)_3$ CH

SOLUBILITY IN VARIOUS SOLVENTS
(Dudley and Garzoli, 1948)

Solvent	t°	Gms. $Ga(CH_3CHOHCOO)_3$ per 100 ml. Solution
Water	20	8.9
"	100	21.5
95% Ethyl Alcohol	20	1.5
Ether (Anhydrous)	20	0.015
Acetone (Anhydrous)	20	0.004

Ga **GALLIUM**

CH **GALLIUM OXINE** $Ga(C_7H_6NO)_3$

The solubility product in water is 1.6×10^{-41} (room temperature) and at 18°, 0.092 moles are dissolved in one liter of a saturated solution in chloroform. (LaCroix, 1947).

OH **GALLIUM HYDROXIDE** $Ga(OH)_3$

Oka, 1940 found the solubility of Gallium Hydroxide in water to be 6.3×10^{-10} moles per liter.

Ge **GERMANIUM** Ge

The solubility of Germanium in copper and silver was determined by Owen and Rowlands (1940) by means of X-Rays.

The system Ge + Sb was studied by Stohr and Klemm (1940).

Cl **GERMANIUM tetra CHLORIDE** $GeCl_4$

The following systems have been investigated:

$GeCl_4$ + Diphenyl Ether	Sisler and Cory, 1947
$GeCl_4$ + Anisole	Sisler, et.al., 1948
$GeCl_4$ + Phenetole	" " "
$GeCl_4$ + Methyl - m - Cresyl Ether	" " "
$GeCl_4$ + Methyl - o - Cresyl Ether	" " "
$GeCl_4$ + n - Propyl Phenyl Ether	" " "
$GeCl_4$ + Tetra Hydro Pyran	Sisler, Batey, Pfahler, and Mattair, 1948
$GeCl_4$ + Tetra Hydro Furan	" " " " " "
$GeCl_4$ + Diethyl Ether	" " " " " "

H **HYDROGEN** H_2 See also p. 91

SOLUBILITY OF HYDROGEN IN WATER UP TO 10 ATM. PRESSURE
(Cassuto, 1904)

The author's data were plotted, and the following rounded values read from the curve. See note p.363 .

Total Pressure CM	k	
	19.5°	23°
100	0.01797	0.01736
200	.01795	.01735
300	.01793	.01732
400	.01780	.01726
500	.01761	.01708
600	.01731	.01685
700	.01692	.01651
800	.01644	.01610

SOLUBILITY OF HYDROGEN - NITROGEN MIXTURES IN LIQUID CARBON DIOXIDE

(Abdulaev, 1941)

t°	Pressure Atm.	% N_2 in N_2 + H_2 Mixture	Mole % H_2 + N_2 in		Ml. H_2 + N_2 dissolved in 1 gm. Liquid CO_2
			Liquid	Vapor	
0	51	36	1.87	19.20	9.42
	101	31	7.50	35.10	38.40
	151	28	12.70	50.50	65.70
	200	23	18.80	55.20	98.43
10	65	27	2.80	18.10	14.20
	109	24	9.10	35.15	46.22
	143	23	14.05	39.40	72.63
	167	22	17.12	41.50	88.70
	203	20	25.50	43.50	135.20
20	70	25	2.50	16.10	12.61
	76	23	3.50	19.50	17.72
	82	18	5.30	22.10	27.03
	106	17	13.20	30.20	67.30
	135	15	35.30	35.30	189.00

SOLUBILITY OF HYDROGEN IN LIQUID NITROGEN

(Gonikberg, Fastowsky, and Gurvich, 1939)

The authors present the liquid-vapor equilibrium data for the system at pressures up to 181 Kg/cm², and calculated the fugacities in the vapor phase.

Partial pressure of H_2 (Kg. per cm².)	(% H_2) (Probably mole %)			
	-79.0°	-86.1°	-95.4°	-109.0°
20	4.5	4.8	5.4	6.2
40	8.3	9.1	10.7	13.2
60	12.7	14.2	17.1	23.6
80	17.1	19.2	24.3	
100	21.1	24.2	34.3	
120	25.5	31.6		
140	30.9	44.8		
160	37.5			
180	45.8			

SOLUBILITY OF HYDROGEN IN ETHYL ALCOHOL

Henrich (1892) recalculated the data of Bunsen (1877), and his equation expresses the experimental results more closely than does Bunsen's. Henrichs equation: $\beta = 0.06930 - 0.00016654\ t + 0.0000017445\ t^2$ (β = Bunsen coefficient, t = °C) was used to calculate the values below. The solubilities are smaller than those of Maxted and Moon (Vol. I, p. 565), but agree well with those of Carius (1855).

Carius used alcohol of density 0.792 at 20°

t°	β		t°	β	
	Henrich	Carius		Henrich	Carius
0	0.06930	0.06925	15	0.06720	0.06725
5	.06851	.06853	20	.06667	.06668
10	.06781	.06786	25	.06622	.06616

SOLUBILITY OF HYDROGEN IN SEVERAL SOLVENTS

(Sattler, 1940)

The solubility curves are linear up to 150 atm. pressure for each of the solvents listed.

	Hexane	Cyclohexane	m-Xylene	Benzene	
t°	35.2	35.2	35.2	35.2	72.6
P. (atm.)	140.7	149.7	150.7	150.2	148.0
cc H_2 dissolved per gm. Solvent	23.63	16.53	11.52	11.77	15.11

SOLUBILITY OF HYDROGEN IN OILS

Oil	t°	Ml. H_2 (0°, 760 mm) Dissolved in 100 ml. Oil	
Lard	40	5.0	(Schaffer and Haller, 1943)
Butter Oil	40	5.4	"
"	60	6.8	"
Cottonseed Oil	40	4.7	"
"	22	4.2	(Vibrans, 1930)
Paraffin Oil	32	4	(Nasini and Corinaldi, 1932)

SOLUBILITY OF HYDROGEN IN n-BUTANE

(Nelson and Bonnell, 1948)

t°C	Pressure Atm.	Mole % H_2 in Liquid	Mole % H_2 in Vapor	t°C	Pressure Atm.	Mole % H_2 in Liquid	Mole % H_2 in Vapor
23.9	22.2	2.0	83.2	115.6	38.6	3.2	-
(75°F)	78.6	6.2	-	(240°F)	48.9	5.1	42.0
	103.0	7.4	-		65.9	7.5	-
82.2	42.6	4.0	62.7		71.0	8.3	-
(180°F)	60.8	6.3	-		91.8	11.1	62.4
	69.0	7.0	-				
	93.6	9.9	83.3				
	105.8	11.1	-				

SOLUBILITY OF HYDROGEN IN LIQUID METHANE

(Pastowsky and Gonikberg, 1940)

°K	Total Pressure Kg/cm²	Mole % H_2 in Liquid	Mole % H_2 in Vapor	°K	Total Pressure Kg/cm²	Mole % H_2 in Liquid	Mole % H_2 in Vapor
90.3	49	2.4	96.8	103.1	39	2.2	94.7
	76	3.6	97.5		77	4.0	96.4
	102	5.0	96.9		104	5.1	96.1
	139	6.4	-		111	5.2	-
	164	8.1	96.8		146	7.5	95.8
	171	8.2	96.4		175	10.5	95.7
	206	-	94.8		234	13.8	94.2
	221	9.7	94.4				

°K	Total Pressure Kg/cm²	Mole % H_2 in Liquid	Mole % H_2 in Vapor	°K	Total Pressure Kg/cm²	Mole % H_2 in Liquid	Mole % H_2 in Vapor
110.0	32	3.3	92.5	122.0	36	3.2	86.9
	49	4.2	92.7		77	6.3	92.5
	66	5.8	93.6		96	9.2	91.1
	78	6.4	-		112	9.9	89.8
	90	7.7	94.2		140	11.6	88.8
	97	8.5	93.6		187	16.2	87.7
	103	8.7	91.9	127.0	37	3.8	85.5
	138	11.1	91.2		62	6.7	87.7
	141	11.9	92.0		85	9.3	89.3
	187	15.6	91.0		131	14.3	86.9

SOLUBILITY OF HYDROGEN IN RUBBER

(Carpenter, 1947)

The Rubber was made up into cylinders by vulcanization from the following mixture: Rubber (smoked sheet) 100.0 parts by wt., Sulfur 2.5 parts, Zinc Oxide 3.0 parts, Stearic Acid 1.0 parts, Agrite White 0.5 parts, Mercaptobenzthiazole 0.5 parts. The cylinders were 0.447 cm radius x 20 cm long and the circular ends were sealed off with tin foil. The experiments were carried on in the dark. Using an alternate method of calculation, results smaller than those below by 0.4×10^{-6} were obtained. Results are at one atmosphere pressure.

t°	cc H_2 per 100 cc Rubber	Gms. H_2 per cc Rubber
21	2.4	-
25	2.6	-
30	-	2.70×10^{-6}
35	-	2.73×10^{-6}
40	-	2.92×10^{-6}

The author compares his data with those calculated from the work of other authors:

21	1.0	(Venable and Fuwa, 1922)
25	4.0	(Barner, 1941)

The solubility of Hydrogen in aqueous gelatin solutions was determined by Eversole and Hanson, 1940.

SOLUBILITY OF HYDROGEN IN POLYSTYRENE

(Newitt and Weale, 1948)

170°	P (atm.) of H_2:	306.5	243	233	224.5	142	80
	$\frac{\text{cc. } H_2 \text{ (at 0°, 1 atm.) per gm. of Polystyrene}}{}$:	11.95	9.66	9.42	8.48	5.35	2.89
72°	$\frac{\text{P atm. } (H_2)}{\text{cc. } H_2 \text{ (at 0°, 1 atm.) per gm. of Polystyrene}}$:	186 11.33	95 5.63				

Liquid-vapor equilibrium data have been determined for the following systems:

$H_2 + N_2$	107.7°K	10 - 100 Atm.	Shtekkel and Tsin, 1939
$H_2 + CH_4$	"	"	"
$H_2 + N_2 + CH_4$	"	"	"
$H_2 + CH_4$	-85° to -115°	up to 80 Atm.	Likhter and Tikhonovich,
$H_2 + CH_4 + C_2H_4$	"	"	" 1940
$H_2 + C_2H_4$			Likhter and Tikhonovich, 1939
$H_2 + CH_4 + C_2H_6$			Levitskaya, 1941
$H_2 + C_6H_6$		up to 3000 Atm.	Ipat'ev, Teodorovich, Brestkin, and Artemovich, 1948
H_2 + Iso-Butane	100° - 250°	500 - 3000 lbs/sq.in.	Dean and Tooke, 1946
H_2 + 2,2,4 Trimethyl Pentane	100° - 302.5°	500-5000 "	"
H_2 + Mixed Isomeric Decanes	200° - 300°	"	" "

Thermodynamic calculations of the solubility of Hydrogen at low temperatures and high pressures in N_2, CO, CH_4, C_2H_4, and C_2H_6 were made by Gonikberg, 1940, and for the solubility in H_2O and C_6H_6 at high pressures by Gonikberg, 1947.

A nomograph for the solubility of Hydrogen in liquid ammonia, based on the results of Wiebe and Tremesone and Wiebe and Gaddy (Vol. I, p. 563) is given by Davis, 1941a.

DATA FOR THE SOLUBILITY OF HYDROGEN IN THE FOLLOWING METALS HAVE BEEN DETERMINED

Al Rontgen and Winterhager (1939), Ransley and Neufeld (liquid and solid) (1948), Baukloh and Oestelen (and some alloys) (1938)

Cu Miller (1939)

Fe Armbruster (1943), Sieverts, Zapf, and Moritz (1938) (also D_2)

Mg Sauerwald (1949) (and in alloys with Al and Zn) (all at 760°), Rontgen and Winterhager (1939)

Mn Sieverts and Moritz (1937)

Nb Sieverts and Moritz (1941) (also D_2)

Ni Sieverts and Danz (1941), Armbruster (1943)

Pd Sieverts and Danz (1937) (and mixtures with D_2), Owen (1944), Wagner (alloys) (1943)

Zr Hall, Martin, and Rees (1945) (and in Zr - O system)

BORIC ACID H_3BO_3 See also p. 57 BO

SOLUBILITY OF BORIC ACID IN ORGANIC SOLVENTS
(Semenchenko and Shakparonov, 1948a)

In Water		In 96% Formic Acid		In Glycerin		In Glycol		In Methyl Alcohol		In Acetone		In Isoamyl Alcohol	
%	t°	%	t°	%	t°	%	t°	%	t°	%	t°	%	t°
1	-0.2*	2	6.2**	20.2	21	22.2	27.9	19.0	0.6	1.0	8.8	3.7	12
2	-0.4*	2	17.6	23.8	38.0	25.1	41.6	21.0	14.8	1.25	28.3	4.7	23.4
4	13.2	2.5	22.5	27.5	54.5	27.0	50.0	23.0	28.7			5.4	28.6
5	23.1	3	28.2	30.0	63.2							6.0	37.1
6	29.6	3.5	32.9	34.0	71.8							6.4	40.8
7	35.5	4	36.5	38.0	86.7							6.5	41.3

* Solid Phase = Ice

** Solid Phase = Formic Acid

% = Wt. % H_3BO_3 in Solution

t° = Temperature of crystallization of H_3BO_3

HYDROGEN BROMIDE HBr Br

SOLUBILITY OF HYDROGEN BROMIDE IN WATER AT 25°
(Bates and Kirschman, 1919)

Partial Pressure HBr in mm.	Moles HBr Dissolved per 1000 gms. H_2O	Partial pressure HBr in mm.	Moles HBr Dissolved per 1000 gms. H_2O
0.00151	6.0	0.0226	9.0
.00370	7.0	.059	10.0
.0089	8.0	.151	11.0

SOLUBILITY OF HYDROGEN BROMIDE IN CHLOROFORM AND CARBON TETRACHLORIDE
(Howland, Miller, and Willard, 1941)

The solutions obey Henry's law.

Solvent	t°	Mole Fraction HCl Dissolved at 1 Atm. Partial Pressure
Chloroform	0	0.0754
	15	.0545
	25	.0454
Carbon Tetrachloride	0	.0628
	15	.0452
	25	.0382

The solubility of HBr in benzene from 8 to 630 mm. pressure and 30° to 50° has been determined by Kapustinski and Maltsev, 1940. At 30° the Henry's law constant is $15.8 \pm .5$ from 0.01 to 0.74 atm. partial pressure of HBr.

The phase diagram of the system HBr - DBr is given by Clusius, 1946.

CN HYDROCYANIC ACID HCN

The liquid-vapor equilibrium and liquid densities in the system Hydrogen Cyanide - Cyanogen Chloride at 15° are reported by Gordon and Benson (1946).

FREEZING POINTS OF MIXTURES OF HYDROCYANIC ACID AND DiETHYL ETHER
(Birckenbach and Buchner, 1940)

(Selected Data)

t°	Mol. % $(C_2H_5)_2O$	Solid Phase	t°	Mol. % $(C_2H_5)_2O$	Solid Phase
-17.5	4.8	HCN	-88.0	52.7	$HCN \cdot (C_2H_5)_2O$
-22.5	13.1	"	-95.8	55.9	"
-29.1	20.0	"	-102.6	57.8	"
-34.5	25.8	"	-107.0	60.5	"
-39.2	29.2	"	-114.0	64.6	"
-44.5	33.9	"	-117.0	69.5	"
-53.4	38.7	"	-119.3	72.3	"
-56.5	40.6	"	-121.5	78.3	$HCN \cdot (C_2H_5)_2O + (C_2H_5)_2O$
-63.4	44.3	"	-119.8	82.1	$(C_2H_5)_2O$
-70.0	46.4	"	-118.5	87.4	"
-77.9	48.7	"	-118.0	90.8	"
-82.6	49.9	"	-116.8	100.0	"

Cl HYDROGEN CHLORIDE HCl

SOLUBILITY OF HYDROGEN CHLORIDE IN WATER AT 25°
(Bates and Kirschman, 1919)

Partial Pressure HCl in mm.	Moles HCl Dissolved per 1000 gms. H_2O	Partial Pressure HCl in mm.	Moles HCl Dissolved per 1000 gms. H_2O
0.0182	4.0	0.844	8.0
.0530	5.0	1.93	9.0
.140	6.0	4.20	10.0
.348	7.0		

SOLUBILITY OF HYDROGEN CHLORIDE IN ETHYL ALCOHOL SOLUTIONS AT 25°
(Jones, Lapworth, and Lingford, 1913)

Partial Pressure of HCl in mm.	Absolute Alcohol	Alcohol + 0.5 mols. H_2O per liter	Alcohol + 1.0 mols H_2O per liter
		Mols. HCl per liter	
0.5	0.84	1.11	1.40
1.0	1.39	1.65	1.90
2.0	2.06	2.27	2.46
3.0	2.55	2.70	2.89
4.0	2.94	3.06	3.20

FREEZING POINTS IN THE SYSTEM HYDROGEN CHLORIDE - CHLORINE

(Wheat and Browne, 1940)

t°	Mole % Cl_2	Solid Phase	t°	Mole % Cl_2	Solid Phase
-112	0.0	HCl	-120	40.4	$HCl \cdot Cl_2$
-114	6.7	"	-116	44.8	"
-117	12.5	"	-115	49.4	"
-120	17.0	"	-116	54.0	"
-122	19.6	"	-117	57.3	"
-125	23.0	"	-120	60.0	"
-128	25.6	"	-124	63.5	"
-129	26.3	$HCl + 2HCl \cdot Cl_2$	-128	66.0	$HCl \cdot Cl_2 + Cl_2$
-123	30.6	$2HCl \cdot Cl_2$	-122	68.7	Cl_2
-122	32.2	"	-117	72.6	"
-122	35.0	"	-112	77.5	"
-124	37.6	"	-109	82.5	"
-125	38.0	$2HCl \cdot Cl_2 + HCl \cdot Cl_2$	-106	88.9	"
			-103	95.0	"
			-102	100.0	"

EQUILIBRIUM IN THE SYSTEM HYDROCHLORIC ACID - DIOXANE - WATER AT 25° C1

(R. A. Robinson and R. C. Selkirk, 1948)

The system separates into two immiscible liquid layers. The binary systems show no immiscibility gaps.

Upper Layer		Lower Layer	
Wt. % HCl	Wt. % H_2O	Wt. % HCl	Wt. % H_2O
3.52	0.85	10.30	8.18
1.17	1.29	11.25	14.40
0.87	2.63	10.91	18.36
.47	4.84	9.59	22.69
.49	7.78	5.76	21.55

FREEZING POINTS IN THE SYSTEM HYDROCHLORIC ACID - NITRIC ACID

(Kogan and Nikolaev, 1937)

t°	HNO_3		Solid Phase	t°	HNO_3		Solid Phase
	Wt. %	Mole %			Wt. %	Mole %	
-111.5	0.0	0.0	A	-114.3	13.00	7.78	B
-112.6	3.91	2.30	A	-113	13.84	8.33	B
-113.5	4.87	2.88	A	-110	15.58	9.71	B
-113.8	5.51	3.39	A	-110	15.70	9.78	B
-115.2	6.76	4.03	A	-101.8	24.10	15.54	B
-113.2	4.61	2.66	A	-101.4	24.73	18.66	B
-117	7.28	4.35	A	-99.4	-	17.54	B + C
-117	7.34	4.37	A	-97.4	-	25.00	B
-119	9.17	5.52	A	-86	34.10	23.21	C
-120	9.30	5.57	A	-83	36.33	24.82	C
-122	9.64	5.81	A + B	-83	36.20	24.72	C
-117.8	11.10	6.74	B	-76.8	40.30	28.03	C
-117	11.25	6.83	B	-72	43.80	31.04	C
-116	12.10	6.9<	B	-63.4	48.86	37.76	C
-115	12.39	7.68	B	-61	53.81	40.25	C

t°	HNO_3 Wt. %	HNO_3 Mole %	Solid Phase	t°	HNO_3 Wt. %	HNO_3 Mole %	Solid Phase
-	54.32	40.65	C	-62.2	80.04	70.69	E
-64.8	55.21	41.66	C	-59	81.33	71.76	E
-75	56.36	42.76	C	-61.4	80.62	70.64	E
-77	56.57	43.12	C + D	-57.2	83.46	74.69	E
-75	56.88	43.26	D	-57.5	83.53	75.38	E
-67	56.4	43.78	D	-51.6	83.60	74.52	E
-63.4	58.21	44.63	D	-57.8	83.46	74.88	E
-58	60.80	47.31	D	-58.6	85.40	77.24	E
-57	61.35	47.33	D	-58.4	85.99	78.46	E
-56	62.02	48.66	D	-58.6	85.74	78.83	E
-55.6	62.48	49.02	D	-65.9	85.58	81.71	E
-55.4	62.74	49.46	D	-71.8	89.77	83.89	E
-54.8	63.45	49.91	D	-73.8	90.35	84.17	E
-55	64.36	51.00	D	-73.8	90.39	84.46	F
-58	67.25	54.16	D	-74.2	90.48	83.85	E
-58.6	67.80	54.95	D	-86.2	92.80	88.15	E + F
-67	70.94	58.81	D	-75	94.23	90.34	F
-68.8	71.40	59.08	D	-56.6	95.57	92.51	F
-69.4	71.57	59.29	D	-64.8	95.75	92.79	F
-71.4	71.47	59.52	D	-60	96.42	93.98	F
-76	72.35	60.24	D	-59.4	96.71	94.43	F
-77.8	72.62	60.54	D	-59	96.88	94.62	F
-90	73.43	61.41	D + E	-55	97.56	95.75	F
-82	75.28	63.75	E	-55	98.17	96.48	F
-81	75.53	64.02	E	-41.3	100.0	100.0	F
-75.6	76.93	65.87	E				

Cl

Solid Phases:
A - HCl M. P. -111.5°
B - $3HCl \cdot HNO_3$ (Incongruent melting point -97.4°)
C - $3HCl \cdot 2HNO_3$ M. P. -61°
D - $HCl \cdot HNO_3$ M. P. -54.8°
E - $HCl \cdot 3HNO_3$ M. P. -57.2°
F - HNO_3 M. P. -41.3°

FREEZING POINTS IN THE SYSTEM HYDROCHLORIC ACID - NITRIC ACID - WATER

(Kogan and Nikolaev, 1937)

The authors present the data for about 100 experimental points in the complete system, and express their results in tabular and graphic form on both weight % and mole % bases. The following data were selected from the tables and graphs in order to outline the system.

t°	Wt. % HNO_3	Wt. % HCl	Solid Phase
-78.5	0.0	-	Ice + $HCl \cdot 3H_2O$
-75.5	6.46	18.13	Ice + $HCl \cdot 3H_2O$ + $HNO_3 \cdot 3H_2O$
-26.45	0.0	-	$HCl \cdot 3H_2O$ + $HCl \cdot 2H_2O$
-32	11.19	38.98	"
-48.8	22.78	23.33	"
-50	25.71	23.62	$HCl \cdot 3H_2O$ + $HCl \cdot 2H_2O$ + $HNO_3 \cdot 3H_2O$
-23.5	0.0	-	$HCl \cdot 2H_2O$ + $HCl \cdot H_2O$

t°	Wt. % HNO_3	Wt. % HCl	Solid Phase
-41.0	26.28	34.74	$HCl \cdot 2H_2O + HCl \cdot H_2O$
-64	33.00	24.00	$HCl \cdot 2H_2O + HCl \cdot H_2O + HNO_3 \cdot 3H_2O$
-43	-	0.0	$Ice + HNO_3 \cdot 3H_2O$
-70	-	0.0	$HNO_3 \cdot 3H_2O + HNO_3 \cdot 2H_2O$
-48.2	63.32	8.56	"
-57	48.76	20.78	"
-73.8	35.66	27.68	$HNO_3 \cdot 3H_2O + HNO_3 \cdot 2H_2O + HCl \cdot H_2O$
-84.5	-	0.0	$HNO_3 + HNO_3 \cdot H_2O$
-84	63.48	18.37	$HNO_3 + HNO_3 \cdot H_2O + HCl \cdot H_2O$
-86.2	92.80	7.20	$HNO_3 + HCl \cdot 3HNO_3$
-92	84.46	12.56	$HNO_3 + HCl \cdot 3HNO_3 + HCl \cdot H_2O$
-90	73.43	26.57	$HCl \cdot HNO_3 + HCl \cdot 3HNO_3$
-96	67.32	27.74	$HCl \cdot HNO_3 + HCl \cdot 3HNO_3 + HCl \cdot H_2O$
-77	56.57	43.43	$3HCl \cdot 2HNO_3 + HCl \cdot HNO_3$
-108	48	48	$3HCl \cdot 2HNO_3 + HCl \cdot HNO_3 + HCl \cdot H_2O$
-99.4	39	61	$3HCl \cdot HNO_3 + HCl \cdot H_2O$
-122	9.64	90.36	$HCl + HNO_3 \cdot 3HCl$
-71	72.65	18.14	$HNO_3 + HCl \cdot H_2O$
-47	28.20	23.45	$HNO_3 \cdot 3H_2O + HCl \cdot 2H_2O$

Cl

The authors did not determine the freezing points along the equilibrium curves involving $HCl + HCl \cdot H_2O$, $HCl + 3HCl \cdot HNO_3$, $3HCl \cdot HNO_3 + 3HCl \cdot 2HNO_3$, and the corresponding ternary invariant points, all of which lie in the region containing more than 60% HCl.

SOLUBILITY OF HYDROGEN CHLORIDE IN ORGANIC MIXTURES

(Brown and Brady, 1949)

Solutions of one mole of each of the following compounds in ten moles of toluene were held at -78.51° and the Henry's law constants determined in the equation $p = Kx$ where x is the mole fraction HCl in solution.

	K (mm)		K (mm)
Tri Fluoromethyl Benzene	332	o-Xylene	286
Chlorobenzene	318	m-Xylene	278
Benzene	308	Pseudocumene	272
Toluene	299	Hemi Mellitene	265
p-Xylene	294	Mesitylene	254

SOLUBILITY OF HYDROGEN CHLORIDE IN ORGANIC SOLVENTS

(O'Brien and King, 1949)

K = Henry's law constants from: $p = kM$ where M is the moles HCl per 1000 gms. solvent and P is measured in atmospheres.

N = Mole fraction solubility of HCl at a partial pressure of one atmosphere.

	t°	k	N		t°	k	N
Phenetole	10	1.02	0.151	Diphenyl Ether	25	3.33	0.0494
"	20	0.90	.120	" "	30	3.52	.0442
"	25	.70	.107	m-Nitro Toluene	25	1.65	.0768*
n-Butyl Phenyl Ether	20	1.21	.110	" "	35	2.08	.0614
" " "	25	1.37	.100				

* O'Brien and Kenny, 1940

SOLUBILITY OF HCl IN SEVERAL ORGANIC SOLVENTS AT 25°

(O'Brien, Kenny, and Zuercher, 1939)

(O'Brien and Kenny, 1940)

p = partial pressure of HCl

m = Moles dissolved in 1000 gms. of solvent.

Cl

Ethylene Glycol		Benzene		Nitrobenzene	
p (Atm.)	m	p (Atm.)	m	p (Atm.)	m
0.0008	1.33	0.026	0.014	0.059	0.030
.0025	2.27	.078	.040	.213	.110
.0032	2.45	.100	.047	.278	.146
.0046	2.72	.111	.048	.312	.161
.0074	3.02	.197	.096	.428	.225
.0075	3.07	.211	.112	.654	.319
.0086	3.11	.391	.191	.636	.323
.0079	3.13	.601	.273	.689	.338
.0357	4.66				
.135	6.57	m-Nitrotoluene		o-Nitrotoluene	
.139	6.63				
.172	6.92	p (mm)	m	p (mm)	m
.424	8.78	13.3	0.0116	1.9	0 0233
		44.3	.0343	53.1	.0382
n-Hexane		56.7	.0438	112	.0821
		116	.0918	113	.0839
p (mm)	m	122	.0939	224	.164
15.7	0.0042	132	.1037	269	.202
28.7	.0073	167	.1385	340	.259
49.2	.0111				
81.5	.020				

SOLUBILITY OF HCl IN CYCLOHEXANE

(Wiegner, 1941)

Results at 10.84°

Partial Pressure HCl (mm)	N_{HCl}	Partial Pressure HCl (mm)	N_{HCl}
18.8	0.00049	475.9	0.00878
178.9	.00384	568.9	.01030
263.0	.00486	665.0	.01230
372.0	.00712		

Results at 40°

Partial Pressure HCl (mm)	N_{HCl}	Partial Pressure HCl (mm)	N_{HCl}
58.0	0.00094	366.3	0.00516
164.9	.00238	465.4	.00681
271.5	.00401	543.4	.00787

The liquid-vapor compositions in the system HCl-n Butane at 70°, 120°, and 170° F. are reported by Ottenweller, Holloway, and Weinrich, 1943.

SOLUBILITY OF HYDROGEN CHLORIDE IN BENZENE DERIVATIVES

Cl

(O'Brien, 1941)

Each of the solutions obeyed Henry's law, and the values below are the reciprocals of the Henry's-law constant.

Solvent	t°	Moles HCl per 1000 gms. of Solvent at 1 Atm. Partial Pressure of HCl
Benzene	30	2.33
"	40	2.91
Chlorobenzene	30	4.65
"	40	5.71
Nitrobenzene	20	1.59
"	25	1.77
"	30	2.08
"	40	2.51

SOLUBILITY OF HYDROGEN CHLORIDE IN CARBON TETRACHLORIDE AND CHLOROFORM

(Howland, Miller, and Willard, 1941)

The solutions were shaken intermittantly, and the total pressure of the vapor was measured (not the volume). The solutions were found to obey Henry's law very well, and the authors indicate several possible sources of error which may have been encountered by Hamai (Vol. I, p. 577).

In Carbon Tetrachloride		In Chloroform	
t°	Mole Fraction HCl Dissolved at 1 Atm. Partial Pressure	t°	Mole Fraction HCl Dissolved at 1 Atm. Partial Pressure
0	0.02448	0	0.0354
20	.01779	15	.02645
25	.01627	25	.02227

PERCHLORIC ACID $HClO_4$

ClO

SOLUBILITY IN WATER

(Brickwedde, 1949)

The freezing points of various solutions of Perchloric Acid were determined from cooling curves and the results do not agree well with those of van Wyk (Vol. I, p. 578). The author points out several factors which make it difficult to evaluate the older work. The precision of the present measurements was excellent. Extensive tables of the densities of Perchloric Acid Solutions are also given. The following data were read by the author from a plot of the experimentally determined points.

$HClO_4$

t°	Gms. $HClO_4$ per 100 gms. Sat. Sol.	Solid Phase
0	0	H_2O
-1.87	5	"
-4.25	10	"
-7.37	15	"
-11.75	20	"
-18.2	25	"
-26.5	30	"
-39.1	35	"
-56.8	40	"
-59.7	40.7	$H_2O + HClO_4 \cdot xH_2O$
-57.0	42	$HClO_4 \cdot xH_2O$
-53.2	44	"
-49.6	46	"
-46.8	48	"
-45.0	50	"
-45.4	52	"
-49.1	54	"
-56.6	56	"
-56.8	56.1	$HClO_4 \cdot xH_2O + HClO_4 \cdot yH_2O$
-51.4	58	$HClO_4 \cdot yH_2O$
-46.7	60	"
-43.2	62	"
-40.5	64	"
(-38.4)	66	"
-29.9	70	$HClO_4 \cdot zH_2O$

Sumarokova and Usanovich (1946) report the conductivities, densities and viscosities of mixtures of Perchloric Acid with Acetic Acid, Mono-, Di-, and Tri-Chlor Acetic Acid.

F HYDROGEN FLUORIDE HF

The liquid-vapor equilibrium in the systems $HF - H_2O$ and $HF - H_2SiF_6 - H_2O$ at atmospheric pressure were determined by Munter, Aelpi, and Kossatz, 1947. The azeotropic solution in the system $HF - H_2O$ boils at 112.0° (750.2 mm) and contains 38.26% HF. An all-silver apparatus was used.

Mutual solubilities between HF and Isobutane, n-butane, and propane from 0° - 50° were determined by Butler, Miles, and Kuhn, 1946 with varying amounts of water added.

I HYDROGEN IODIDE HI

SOLUBILITY OF HYDROGEN IODIDE IN WATER AT 25°

(Bates and Kirschman, 1919)

Partial Pressure HI in mm	Moles HI Dissolved per 1000 gms. H_2O
0.00057	6.0
.00182	7.0
.0065	8.0
.0295	9.0
.132	10.0

IO PERIODIC ACID $HIO_4 \cdot 2H_2O$

SOLUBILITY OF PERIODIC ACID IN WATER

(Gyani and Gyani, 1949)

The temperature control was not too exact and the two solid phases were not identified.

t°	Gms. $HIO_4 \cdot 2H_2O$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $HIO_4 \cdot 2H_2O$ per 100 gms. Sat. Sol.	Solid Phase
0	77.91	"A"	35	79.50	"B"
20	78.57	"A"	37	79.66	"B"
25	78.74	"A"	40	80.30	"B"
29.5	-	"A + B"	45	80.78	"B"
33	79.32	"B"			

SOLUBILITY OF PERIODIC ACID IN CONCENTRATED NITRIC ACID (Sp. Gr. = 1.42)
(Willard, 1939)

t°	Gms. H_5IO_6 per 100 cc	Gms. H_5IO_6 per 100 gms. Sat. Sol.
$-12 \pm 1°$	5.68	3.95
$+26 \pm .05°$	7.82	5.41

NITRIC ACID HNO_3 NO

The partial pressures of water and Nitric Acid over mixtures containing 5 - 100% HNO_3 at 0° and 20° were determined by Wilson and Miles (1940).

The electrical conductivities and viscosities in the system $HNO_3 + H_2O$ at 0°, 10°, 20°, 30°, 40° are given by Chanukvadze (1947).

Freezing points in the system $H_2SO_4 + HNO_3 + SO_3$ have been determined by Holmes, Hutchison, and Zieber, 1931.

Vapor pressures in the system $H_2SO_4 + HNO_3 + SO_3$ at 30°, 40°, and 50° are given by Gelfman, 1946. The heats of mixing at 30° are reported by Gelfman, 1947.

Some melting points in the system $HNO_3 - SO_3$ are given by Atelin and Borodastova (1949).

RECIPROCAL SOLUBILITY IN THE SYSTEM $HNO_3 + NO_2$
(Klemenc and Spiess, 1947)

The authors determined the composition of the coexisting liquid phases up to the consolute point using anhydrous HNO_3, and then in $HNO_3 + H_2O$ where the HNO_3 was 21 N. The data agree well with the limited results of Bousfield but not with those of Pascal and Garnier (both p. 582, Vol. I). The present determinations were made by observations of the "cloud point" of known mixtures.

t°	Anhydrous HNO_3 Wt. % HNO_3		21N HNO_3 Wt. % HNO_3	
	HNO_3 in NO_2	NO_2 in HNO_3	HNO_3 in NO_2	NO_2 in HNO_3
-20	2.3	47.4	0.7	56
-15	2.7	47.2	1.7	55.5
-10	3.3	47.0	2.6	55.0
- 5	3.9	46.9	3.5	54.5
0	4.0	46.7	4.4	54.0
5	5.5	46.6	5.4	53.5

t°	Anhydrous HNO_3 Wt. % HNO_3		21N HNO_3 Wt. % HNO_3	
NO	HNO_3 in NO_2	NO_2 in HNO_3	HNO_3 in NO_2	NO_2 in HNO_3
10	6.3	46.4	6.5	52.9
15	7.3	46.3	7.7	52.2
20	8.2	46.2	9.2	52.3
25	9.2	46.0	11.0	50.2
30	10.2	45.9	13.2	48.6
35	11.3	45.6	16.4	46.3
40	12.5	45.2	21.8	42.0
42.6	-	-	31.7	31.7
45	13.9	44.6	(upper consolute point) .	
50	15.9	43.4		
55	18.9	41.2		
60	25.8	36.6		
61	31.4	31.4		
	(Upper consolute point)			

Data for the equilibrium between NO, NO_2 and solutions of HNO_3 at 0° are given by Epstein, 1939.

Partial vapor pressures and boiling points in the system HNO_3 + H_3PO_4 + H_2O are given by Babkin, 1937.

The system HNO_3 + H_2SO_4 + H_2O has been studied as follows:

1. Boiling points and liquid-vapor equilibria (Berl, 1922)
2. Heats of mixing (McDavid, 1922)
3. Specific heats of mixtures (Pascal and Garnier, 1920)
4. An Enthalpy vs. temperature nomograph is given by McCurdy and McKinley, 1942.

OH WATER HOH See also ORGANIC INDEX

SOLUBILITY OF WATER IN LIQUID CARBON DIOXIDE

(Stone, 1943)

Liquid Carbon Dioxide and Water were rotated together in a metal tank for eight hours and then brought to equilibrium in a thermostat for 24 - 48 hours. The solution was then passed through a needle valve to vaporize it and the components were trapped in magnesium perchlorate and sodium-calcium hydrate and weighed. From 4 to 9 determinations were made at each temperature.

t°	% H_2O
-29	0.0195 ± 0.0011
5.08	.0639 ± 0.0020
15.0	.0900 ± 0.0027
22.6 ± 1	.104 ± 0.0078

SOLUBILITY OF WATER IN ORGANIC SOLVENTS AT 4.5°

(Copley, Ginsberg, Zellhoefer, and Marvel, 1941)

The solubilities were determined at 32.2° using a partial pressure of water equal to the vapor pressure at 4.5°.

Solvent	Mole Fraction H_2O
Triethylene Tetramine	0.588
Tetraethylene Pentamine	.622
Trimethyl Triethylene Tetramine	.398
Pentamethyl Triethylene Tetramine	.523
Triacetyl Trimethyl Triethylene Tetramine	.610
Hexamethylene Diamine	.382
N, N-Dimethyl Acetamide	.232
Ethylene Glycol	.207
Glycerol	.239
Carbitol	.126
Dimethyl Ether of Tetraethylene Glycol	.099
Triethyl Phosphate	.104

SOLUBILITY OF WATER IN ORGANIC SUBSTANCES AT ROOM TEMPERATURE OH

(Shanley and Greenspan, 1947)

	Gms. H_2O per 100 gms. Solvent
Methyl Methacrylate	1.0
Allyl CR-39 Monomer	3.0
Dimethyl Phthalate	1.6
Diethyl Phthalate	1.0
Ethyl Acetate	3.5
Aniline	3.5

MUTUAL SOLUBILITY OF di-n-PROPYL AMINE AND WATER

(Hobson, Hartman, and Kanning, 1941)

t°	Gms. Amine per 100 gms. Sat. Sol.	t°	Gms. Amine per 100 gms. Sat. Sol.	t°	Gms. Amine per 100 gms. Sat. Sol.
52.6	1.96	-4.5	25.21	17.5	73.33
44.1	2.42	-4.8	33.69	24.7	78.69
36.1	2.91	-2.9	44.68	31.2	82.15
12.2	5.86	-1.5	47.54	39.0	85.83
-0.6	9.33	4.2	60.40	49.0	89.26
-2.2	12.27	8.0	64.06	74.8	93.25
-3.5	15.28				

The solubility of water in butanol and benzyl alcohol was determined by Durand-Gasselin and Duclaux (1940). The effect of added electrolytes was also studied.

Schunke (1894) reports the solubility of water in diethyl ether to be:

10° - 0.0270 gms. H_2O per gm. $(C_2H_5)_2O$

20° - 0.0272 gms. H_2O per gm. $(C_2H_5)_2O$

SOLUBILITY OF WATER IN ORGANIC COMPOUNDS

(Berkengeim, 1941)

Results are in grams of H_2O per 100 gms. of saturated solution.

		0°	10°	20°	40°
Aviation Benzene d_4^{20} 0.8596	0.0075(-13°)	0.16	0.023	0.029	0.038
Cracking Benzene d_4^{20} 0.8576	.0080(-10°)	.013(-1.5°)	.020	.027	.035
Alkylbenzene d_4^{20} 0.8675	.0065(-10°)	.011	.014	.018	.023
Isooctane d_4^{20} 0.6947		.0011(-1.5°)	.0037	.0055	.0080
Aviation Gasoline B-70		.0011(-5°)	.0033	.0045	.0063
Butyl Alcohol b.p. 116.5°-117°	2.80(-18°)	12.5(-7°)		23.1	26.4
Methyl Ethyl Ketone d_4^{20} 0.8112	upper layer	22.5	18.5	17.2	17.2
	lower layer	55.5	63.3(14°)		74.4
Methyl Propyl Ketone d_4^{20} 0.8107		2.11		3.39	3.62
Isopropyl Ether d_4^{20} 0.7398	0.64(-20°)				
	0.70(-138)	0.75	0.80	0.87	0.91
Benzene b.p. 80.4°	0.066(30°) 0.114(50°)		.040	.053	.084
OH Cyclohexane b.p. 80°				.0087	.015(50°)

Kretschmer and Wiebe (1945) report the solubility of water in many mixtures of ethyl alcohol with hydrocarbons, and in mixtures of hydrocarbons which might be used as fuels.

SOLUBILITY OF WATER IN BENZENE

(Staveley, Jeffes, and Moy, 1943)

The determinations were made by the cloud point method.

t°	Gms. H_2O per 1000 gms. Sat. Sol.	t°	Gms. H_2O per 1000 gms. Sat. Sol.
20	0.570	50.4	1.619
24.7	.685	58.2	2.073
41.4	1.213	58.5	2.190
44.0	1.296	71.0	2.976

Staveley, Jeffes, and Moy (1943) also give data for the solubility of water in mixtures of Benzene plus Nitrobenzene, Aniline, Dimethyl Aniline, Chloroform, Bromo Benzene, and Anisole at several temperatures and concentrations.

SOLUBILITY OF WATER IN HYDROCARBONS

(Joris and Taylor, 1948; Black, Joris, and Taylor, 1948)

Tritium Oxide was used as a tracer and the amount of dissolved water was determined by using a Geiger-Muller counter. In addition to the results below, the authors report the solubility of water in 1, 3-Butadiene, 1-Butene, 2-Butene, Isobutylene, n-Butane, and Isobutane at 3 - 6 atm. total pressure and 5° - 22°. The data below are given in gms. H_2O per 100 gms. of Hydrocarbon at 1 atm. total pressure.

t°	Solubility	t°	Solubility	t°	Solubility
Benzene		Isopentane		1 - Heptane	
10	0.030	6.0	0.00439	10.0	0.0692
20	.0435	15.3	.0066	20.1	.1126
26	.054	20.0	.0094	20.5	.1047
		20.5	.01001	21.2	.1158
n - Pentane		21.3	.0096		
		21.8	.0097	n - Heptane	
5.5	0.0036				
15.0	.0061	n - Octane		10	0.0077
24.8	.0120			20	.0131
		20	0.0142	25	.0151
1, 5 - Hexadiene					
		n - Hexane		Cyclohexane	
13.5	0.0618				
20.2	.0969	20	0.0111	20	0.010

SOLUBILITY OF WATER IN HYDROCARBONS OH

(Griswald and Kasch, 1942)

Weighed amounts of water and hydrocarbons were sealed together in pyrex tubes and the cloud point of each determined. The maximum variation was ± 2°.

Kerosene		Naphtha		S.A.E. 20 Lubricating Oil	
t°	Gms. H_2O per 100 gms. Kerosene	t°	Gms. H_2O per 100 gms. Naphtha	t°	Gms. H_2O per 100 gms. Oil
112	0.1306	159	0.6404	208	0.8070
135	.2313	186	1.2051	215	.8699
169	.5456	203	1.6570	215	.9286
177	.6508	222	2.3649	250	1.6829
185	.8308			259	1.8115
191	.9029	S.A.E. 20 Lubricating Oil		267	2.0819
203	1.3309			272	2.3011
207	1.4377	124	0.1072	269	2.4863
216	1.8281	137	.1365	273	2.5174
228	2.4502	151	.2359	274	2.8142
251	3.1148	189	.4369	281	3.1869
264	4.4436	226	.8022		

SOLUBILITY OF WATER IN ORGANIC HOLOGEN COMPOUNDS

(Staverman, 1941)

Solvent	0°	25°	30°
	Gms. H_2O per 100 gms. Sat. Sol.		
CCl_4	0.0050	0.0116	0.0158
$CHCl_3$	.0530	.0932	.113
CH_2Cl_2	.0849	.167	.196
CH_3CHCl_2	.0460	.0966	.115
CH_2ClCH_2Cl	.0900	.187	.22
CH_2BrCH_2Br	-	.0657	.0715
CH_3CCl_3	.0162	.0339	.042
$CH_2ClCHCl_2$	.062	.119	.159
$CHCl_2CHCl_2$	.0584	.110	.132
CH_2ClCCl_3	.0230	.0555	.060
$CHCl_2CCl_3$	.0162	.0347	.0414

The solubility of water in BrC_2H_4Br from 0° to 75° and vice versa was determined by Shostakovskii and Druzhinin, 1942.

OH

SOLUBILITY OF WATER IN STYRENE AND VICE VERSA

(Lane, 1946)

The determinations were made in two ways: by determination of the cloud points of mixtures, and by titration with Karl Fischer reagent or formaldehyde-sulfuric acid reagent. The results with one method agree amongst themselves more closely than with the results of the other method. Results obtained from cloud points are marked "c".

t°	% H_2O in Styrene	t°	% Styrene in H_2O	t°	% Styrene in H_2O
6	0.032	7	0.029	44	0.040^c
14	$.040^c$	15	$.025^c$	49	$.045^c$
25	.066	24	.033	51	.045
27	$.060^c$	25	$.031^c$	56	$.050^c$
31	.084	32	.036	65	$.058^c$
34	$.080^c$	40	.040		
40	.101				
40	$.100^c$				
45	$.120^c$				
51	.123				

SOLUBILITY OF H_2O IN BUTTERFAT

(Thiel, 1943)

Temperature °	40	60	80	95
Solubility % H_2O	0.19%	0.26%	0.36%	0.47%

The solubility of water in mixtures of water soluble and fat soluble organic solvents was determined by Leikola (1940).

OOH

HYDROGEN PEROXIDE H_2O_2

EQUILIBRIUM IN THE SYSTEM HYDROGEN PEROXIDE - WATER

(Giguere and Maass, 1940)

The authors redetermined the freezing points of mixtures of $H_2O_2 + H_2O$ and found values differing by $\pm$ 2° from those found by Maass and Herzberg (Vol. I, p. 588) and in addition determined the composition of the solid phase present at various temperatures. This was not done by Maass and Herzberg, although the phases H_2O_2, $H_2O_2 \cdot 2H_2O$, and H_2O are listed with their data. This present work indicates clearly H_2O_2 and H_2O form solid solutions throughout the entire range of compositions. The compound $H_2O_2 \cdot 2H_2O$ does form, and is congruently melting, but it divides the phase diagram into two roughly symmetrical halves; e.g. it forms a discontinuous solid solution with each of the components. Mixtures were made from which the solid was separated, and the composition of both solid and liquid determined, as well as the respective melting and freezing points. The solid phase compositions reported below were read from a graph drawn by the authors.

t° (F. pt. of Liq.)	Gms. H_2O_2 per 100 gms. Liquid	*Solid	Solid Phase
-2.2	4.5	1.0	S.S. I
-4.4	8.1	2.0	"
-6.1	9.9	3.5	"
-9.2	14.5	5.5	"
-11.7	17.6	8.5	"
-16.2	22.2	12.5	"
-18.5	24.0	14.3	"
-22.2	27.7	17.5	"
-25.1	30.0	19.5	"
-27.4	31.4	20.6	"
-30.3	33.6	22.0	"
-33.5	36.6	25.5	"
-44.5	42.0	29.1	"
-50.8	44.7	31.5	"
-51.1	46.0	31.6	"
-51.5	45.0*	31.7	S.S. I + S.S. II
-50.2	48.0	-	S.S. II
-50.3	48.6	48.6	$H_2O_2 \cdot 2H_2O$
-50.5	51.1	-	S.S. III
-51.5	54.0	51.5	"
-52.2	56.3	52.5	"
-53.6	58.2	54.5	"
-54.0	60.2	55.5	"
-56.5	60.0*	57.5-85.2	S.S. III + S.S. IV
-50.0	63.5	85.6	S.S. IV
-43.5	68.0	86.5	"
-39.7	70.1	87.2	"
-30.4	76.0	89.5	"
-26.3	78.2	90.5	"
-22.2	80.5	92.1	"
-17.4	85.3	94.0	"
-11.2	90.1	97.0	"
-0.89†	100.0	-	H_2O_2

OOH

S.S. I - Solid Solution of $H_2O_2 \cdot 2H_2O$ in H_2O

S.S. II - " " " H_2O in $H_2O_2 \cdot 2H_2O$

S.S. III - " " " H_2O_2 in $H_2O_2 \cdot 2H_2O$

S.S. IV - " " " $H_2O_2 \cdot 2H_2O$ in H_2O_2

* Read from graph

† Maass, Cuthbertson, and Matheson, 1928

The partial pressures of H_2O and H_2O_2 over mixtures of the two at 30°, 45°, and 60° are also reported by Giguere and Maass (1940a).

SOLUBILITY OF HYDROGEN PEROXIDE IN ORGANIC SUBSTANCES AT ROOM TEMPERATURE

(Shanley and Greenspan, 1947)

Solvent	Gms. 90% H_2O_2 per 100 gms. Solvent
Methyl Methacrylate	18
Di Methyl Phthalate	28
Di Ethyl Phthalate	2.5
Allyl CR-39 Monomer	28

Ethyl Acetate and Aniline are miscible with 90% H_2O_2 in all proportions.

PO PHOSPHOROUS ACID H_3PO_3

FREEZING POINTS IN THE SYSTEM PHOSPHOROUS ACID - DIOXANE
(Mezbenni, 1949)

Mole % Dioxane	Freezing Point°	Solid Phase	Mole % Dioxane	Freezing Point°	Solid Phase
100.0	11.78	D	66.51	6.61	D
98.8	11.32	D	63.75	6.0	D
97.25	11.25	D	63.50	4.0	D
92.5	10.36	D	63.50	-1.5	D
90.8	10.11	D	55.58	-2	D
89.0	9.79	D	53.79	-5	D + P
86.1	9.35	D	53.49	-4	P
84.2	9.19	D	47.8	11.5	P
83.60	9.68	D	39.9	3.7	P
83.25	8.31	D	29.98	22.5	P
79.01	8.99	D	22.2	36.1	P
75.42	8.11	D	20.79	41.0	P
75.03	7.92	D	16.42	49	P
74.20	7.32	D	12.56	56.1	P
73.10	7.92	D	0.0	72.31	P
69.99	6.8	D			

D = $C_4H_8O_2$ P = H_3PO_3

PO PHOSPHORIC ACID H_3PO_4

The system H_3PO_4 - $(C_2H_5)_2O$ - H_2O was studied at 0° by Ust-Kachkintsev and Khlebnikov, 1939.

S HYDROGEN SULFIDE H_2S

Correction to the third edition, Volume I:

p. 596, Top: "Solubility of H_2S in HCl solutions", reference should be: J. Kendall and J. C. Andrews: J. Am. Chem. Soc. 43, 1545 (1921)

SOLUBILITY OF HYDROGEN SULFIDE IN HYDROCHLORIC ACID SOLUTIONS AT 25°
(Kapustinsky and Anvaer, 1941)

These data agree with and extend those of Kendall and Anderson (Vol. I, p. 596).

Hydrochloric Acid			Hydrogen Sulfide		
			Gm. Moles per liter of Solution	Gm. Moles per 1000 gms. Of Water	
Wt. %	Gm. Moles per liter of Solution	Gm. Moles per 1000 gms. of Water	(P.P.=760mm)	(P.P.=760mm)	(Total Pressure =760mm)
0.0			0.1013	0.1227	0.1200
16.8	5.0	5.55	.1098	0.1227	0.1200
20.2	6.1	7.0	.1124	.1291	.1266
23.7	7.3	8.4	.1165	.1375	.1351
28.1	8.8	10.7	.1192	.1462	.1437
34.9	11.4	14.7	.1169	.1542	.1319
*36.5		15.7		.16	.125
*37.7		16.6		.165	.11
*39.0		17.5		.17	.08
*40.3		18.5		.175	.045
*41.5		19.4		.18	.00

*Extrapolated Values

SOLUBILITY OF HYDROGEN SULFIDE IN SODIUM HYDROSULFIDE SOLUTIONS

(Goldschmidt and Larson, 1910)

t°	Moles per liter		t°	Moles per liter	
	NaSH	H_2S		NaSH	H_2S
15	0.1	0.132	35	0.05	0.082
	.2	.129		.1	.082
25	.1	.104	45	.05	.064
	.2	.1035			

SOLUBILITY OF HYDROGEN SULFIDE IN SOLUTIONS OF FERROUS CHLORIDE AND ZINC CHLORIDE CONTAINING HYDROCHLORIC ACID AT 25° S

(Kapustinsky and Anvaer, 1941)

Total P. mm.	Gm. Moles per 1000 gms. H_2O			Total P. mm.	Gm. Moles per 1000 gms. H_2O		
	HCl	$ZnCl_2$	H_2S		HCl	$FeCl_2$	H_2S
7.60	3.9	2.1	0.1157	7.60	1.6	0.9	0.085
7.58	5.0	4.7	.1501	7.60	3.4	1.0	.089
7.55	7.8	1.0	.1345	7.60	7.8	1.1	.108
7.46	9.1	1.5	.1433	7.60	10.6	1.2	.120
7.55	10.6	1.1	.1495	7.60	9	Saturated (less than 20%)	.101
7.50	13.5	0.8	.1416				

SOLUBILITY OF HYDROGEN SULFIDE IN LIQUID SULFUR

(Fanelli, 1949)

The total pressure was one atmosphere.

t°	Gms. H_2S per 100 gms. S.	t°	Gms. H_2S per 100 gms. S.	t°	Gms. H_2S per 100 gms. S.
126	0.057	273	0.179	313	0.186
141	.067	300	.190	388	.182
150	.088	322	.189	398	.173
158	.117	338	.187	402	.171
167	.133	350	.189	427	.141
175	.139	359	.186	437	.116
202	.160	369	.188	440	.098
233	.177	371	.189	444	.065
				Boiling Point	.049

SOLUBILITY OF HYDROGEN SULFIDE IN ETHYL ALCOHOL

(Henrich, 1892; Carius, 1856)

Henrich recalculated Bunsen's data and found an expression which more closely fit the experimental points than did Bunsen's. His equation is $\beta = 18.019 - 0.71259\ t + 0.0088556\ t^2$, where β is the volume of H_2S (measured at 0°, 760 mm) dissolved in 1 volume of alcohol, and the temperature is measured in centigrade degrees. The values below were calculated from this equation. Carius used alcohol of density 0.792 (20°).

t°	β Henrich	β Carius	t°	β Henrich	β Carius
0	18.02	17.89	15	9.32	9.54
5	14.68	14.78	20	7.31	7.42
10	11.78	11.99	25	5.73	5.62

SOLUBILITY OF HYDROGEN SULFIDE IN ANILINE AT 22°

(Bancroft and Belden, 1930)

mm. H_2S	Mg. H_2S Dissolved in 1 cc Aniline	mm. H_2S	Mg. H_2S Dissolved in 1 cc Aniline	mm. H_2S	Mg. H_2S Dissolved in 1 cc Aniline
102	2.74	390	10.6	591	16.4
178	4.64	406	11.3	676	18.6
199	5.32	484	13.2	750	20.8
296	8.13	513	14.3	874	24.0
310	8.45	579	15.8	1160	31.6

Data for the solubility of H_2S in water, benzene, formic acid, acetic acid, acetophenone, and methylene dibromide is given by Gavelli and Falciola, 1904.

S

DISTRIBUTION OF HYDROGEN SULFIDE BETWEEN HYDROCARBONS AND WATER

(Rorschach and Gardner, 1949)

Mixtures of $H_2S + N_2$ were bubbled through the water - hydrocarbon system and the following distribution ratios were found:

Hydrocarbon	t°	Gms. H_2S per gm. of Hydrocarbon using 100% H_2S	Gms. H_2S per gm. of Water using 100% H_2S	K
Benzene	25	0.01088	0.00165	6.65
Gasoline	15	.0137	.002193	5.65
	25	.0127	.00198	6.30
	35	.00891	.001271	7.0
Kerosene	15	.00662	.001815	3.65
	25	.00623	.00207	3.2
	35	.00526	.001665	3.2

$$K = \frac{\text{gms. } H_2S \text{ per gm. of Hydrocarbon}}{\text{gms. } H_2S \text{ per gm. of } H_2O}$$

SOLUBILITY OF HYDROGEN SULFIDE IN SOLAR OIL (Petroleum)

(Avdeeva and Pitelina, 1947)

See note p. 101

Results at 30°

t°	Gms. H_2S per liter of Oil	Volume % H_2S in Gas Phase	Gms. H_2S per liter of Oil
10	3.90	10	0.3
20	3.38	34	1.0
30	3.01	50	1.5
60	2.38	75	2.2
115	1.50	100	3.0

At 26°, 5.7 volumes of H_2S dissolve in one volume of ethyl ether (=8.8 gms. per liter, 0.511 N). - Parsons, 1925.

SOLUBILITY OF HYDROGEN SULFIDE IN MONOETHANOL AMINE SOLUTIONS AT 25°

(Riegger, Tarter, and Lingafelter, 1944)

Results are in terms of moles of H_2S per mole of monoethanol amine in solution. S

t°	Partial Pressure mm. H_2S	Gm. Moles Monoethanol Amine per 1000 gms. H_2O						
		0.6	1.0	1.5	2.0	3.0	4.0	5.0
25	700	1.148	1.086	1.050	1.033	1.011	0.998	0.991
	600	1.126	1.072	1.041	1.025	1.004	.991	.984
	500	1.101	1.058	1.032	1.016	0.996	.980	.974
	400	1.080	1.042	1.020	1.006	.985	.971	.963
	300	1.053	1.022	1.002	0.990	.970	.955	.945
	200	1.027	0.998	0.979	.966	.945	.931	.918
	100	0.986	.956	.934	.919	.893	.870	.852
	50	.934	.902	.876	.856	.819	.784	.758
	25	.866	.833	.802	.777	.730	.687	.643
45	700	1.124	1.051	1.011	0.988	.958	.940	.927
	600	1.097	1.033	0.996	.975	.948	.928	.914
	500	1.070	1.012	.980	.960	.934	.913	.899
	400	1.045	0.993	.961	.943	.918	.897	.880
	300	1.011	.967	.939	.921	.891	.869	.850
	200	0.971	.929	.900	.880	.846	.819	.800
	100	.908	.864	.826	.795	.748	.714	.684
	50	.826	.782	.742	.706	.648	.601	.564
	25	.731	.686	.631	.601	.533	.487	.453
60	700	1.083	1.040	0.998	.968	.934	.909	.891
	600	1.056	1.011	.970	.944	.910	.884	.865
	500	1.027	0.984	.945	.916	.880	.858	.837
	400	0.995	.952	.912	.885	.848	.821	.801
	300	.960	.916	.876	.847	.810	.778	.753
	200	.908	.863	.822	.793	.751	.714	.683
	100	.811	.757	.708	.674	.624	.581	.547
	50	.694	.634	.576	.532	.474	.425	.386
	25	.551	.490	.433	.388	.331	.291	.285

The pressure-composition diagrams of the systems:

H_2S + Propene at -30°, 0°, 15°
H_2S + Propane at -30°, 0°, 15°
H_2S + CO_2 at -52°, -26.8°, 0°

are given by Steckel, 1945.

The liquid-vapor equilibrium in the system H_2S - propane at high pressures was determined by Gilliland and Scheeline, 1940.

Pelabon, 1893 determined the solubility of H_2S in liquid selenium.

SULFURIC ACID H_2SO_4 SO

The system H_2SO_4 - $(C_2H_5)_2O$ - H_2O was studied at -10°, 0°, and 20° by Ust-Kachintsev and Khlebnikov, 1939.

MELTING POINTS IN THE SYSTEM H_2SO_4 + $(SO_3)_2HNO_3$

(Atelin and Borodastova, 1949)

Wt. % $(SO_3)_2HNO_3$	Melting Point	Solid Phase	Wt. % $(SO_3)_2HNO_3$	Melting Point	Solid Phase
0.0	10°	H_2SO_4	44.25	28°	$(SO_3)_2HNO_3$
9.27	8°	"	53.52	53°	"
18.88	2°	"	62.71	66.5°	"
30.05	-6.5°	"	71.07	76°	"
40.48	-16.5°	"			

SO

THE SYSTEM H_2SO_4 + $H_2S_2O_7$ + HSO_3Cl

(Luchinsky, 1940)

The melting points, boiling points, and compositions of the vapor were determined for the entire system. Two compounds are formed: $H_2S_2O_7 \cdot HSO_3Cl$ (M.P. 2.6°) and $H_2S_2O_7 \cdot 2HSO_3Cl$ (M.P. 3.1°). The invariant points are tabulated below.

t°	Mole % H_2SO_4	Mole % $H_2S_2O_7$	Solid Phase
-80.0	0.0	0.0	HSO_3Cl
-109.3	13.90	0.0	$HSO_3Cl + H_2SO_4$
+10.4	100.0	0.0	H_2SO_4
-12	73.1	26.9	$H_2SO_4 + H_2S_2O_7$
+36	0.0	100.0	$H_2S_2O_7$
-38.8	0.0	63.36	$H_2S_2O_7 + H_2S_2O_7 \cdot HSO_3Cl$
-15.4	0.0	44.61	$H_2S_2O_7 \cdot HSO_3Cl + H_2S_2O_7 \cdot 2HSO_3Cl$
-112.6	0.0	16.11	$H_2S_2O_7 \cdot 2HSO_3Cl + HSO_3Cl$
-62	41.5	32	$H_2SO_4 + H_2S_2O_7 + H_2S_2O_7 \cdot HSO_3Cl$
-78.4	36	28	$H_2SO_4 + H_2S_2O_7 \cdot HSO_3Cl + H_2S_2O_7 \cdot 2HSO_3Cl$
-116	10	12	$H_2SO_4 + HSO_3Cl + H_2S_2O_7 \cdot 2HSO_3Cl$

Melting points, densities, and viscosities in the systems H_2SO_4 + $ClCH_2COOH$, H_2SO_4 + $Cl_2CHCOOH$, and H_2SO_4 + Cl_3CCOOH are given by Pushin and Stanojevic, 1946. No compounds were formed.

EQUILIBRIUM IN THE SYSTEM SULFURIC ACID - OXALIC ACID - WATER

(Hill, Goulden, and Hatton, 1946)

Gms. $H_2C_2O_4$ per 100 gms. Sat. Sol.	Gms. H_2SO_4 per 100 gms. Sat. Sol.	Results at 25° d_{15}^{25}	Solid Phase
10.2	0.0	1.043	$H_2C_2O_4 \cdot 2H_2O$
6.6	9.6	1.078	"
4.7	15.4	1.119	"
3.6	21.5	1.165	"
2.9	29.5	1.174	"
2.3	38.6	1.272	"
2.6	47.1	-	"
4.6	55.1	1.469	
7.8	59.6	1.516	$H_2C_2O_4 \cdot 2H_2O + H_2C_2O_4$
5.2	67.4	1.600	$H_2C_2O_4$
4.0	74.4	1.662	"
4.1	85.9	1.771	"
4.6	89.9	1.788	"
4.6	91.6	-	"

Results at 60°

Gms. $H_2C_2O_4$ per 100 gms. Sat. Sol.	Gms. H_2SO_4 per 100 gms. Sat. Sol.	d_{15}^{60}	Solid Phase
31.6	0.0	1.129	$H_2C_2O_4 \cdot 2H_2O$
25.2	7.2	1.150	"
20.2	14.2	-	"
16.6	20.2	-	"
12.3	33.2	1.294	"
12.1	38.5	1.334	"
13.1	43.5	1.387	"
15.1	44.9	-	"
20.5	44.6	-	$H_2C_2O_4 \cdot 2H_2O + H_2C_2O_4$
19.4	46.4	1.469	$H_2C_2O_4$
16.5	50.5	1.493	"
13.9	55.6	1.514	"
9.5	65.0	1.583	"
8.6	67.7	1.610	"
7.2	79.6	1.673	"
8.3	84.0	-	"
7.6	71.2	-	"
8.7	86.5	1.704	"

PYROSULFURIC ACID $H_2S_2O_7$ SO

FREEZING POINTS IN THE SYSTEM PYRO SULFURIC ACID - DIOXANE

(Mezhenni, 1948)

Mole % Dioxane	Freezing Point	Solid Phase	Mole % Dioxane	Freezing Point	Solid Phase
0.0	34° a	$H_2S_2O_7$	66.42	78°	1:2
8.08	21° a	"	67.85	79.1°	"
23.75	16.6° a	"	69.01	76°	"
29.50	19.9° a	"	70.02	59.9°	"
40.60	24° a	$H_2S_2O_7$ + 1:2	75.42	49.1°	"
56.2	64.3° a	1:2	84.59	27.0°	"
60.63	69.5° a	"	93.6	7.0°	$C_4H_8O_2$ + 1:2
64.98	74.8°	"	100.0	11.78°	$C_4H_8O_2$

a = Melting points 1:2 = $H_2S_2O_7 \cdot 2C_4H_8O_2$

SULFAMIC ACID HSO_3NH_2 SON

SOLUBILITY OF SULFAMIC ACID IN WATER

(Cupery, 1938)

t°	Gms. HSO_3NH_2 per 100 gms. H_2O	t°	Gms. HSO_3NH_2 per 100 gms. H_2O
0	14.68	50	32.82
10	18.56	60	37.10
20	21.32	70	41.91
30	26.09	80	47.08
40	29.49		

100 cc of a saturated solution of sulfamic acid in water contain 14.94 gms. HSO_3NH_2 at 12° and 40.00 gms. at 78°. (Oberhauser and Urbina, 1946).

SON

SOLUBILITY OF SULFAMIC ACID IN ORGANIC SOLVENTS AT 25°
(Cupery, 1938)

Solvent	Gms. HSO_3NH_2 per 100 gms. Solvent	Solvent	Gms. HSO_3NH_2 per 100 gms. Solvent
Methanol	4.3	Ether	0.009
Ethanol (2% Benzene)	1.7	Formamide	20.0
Acetone	0.4		

SOLUBILITY OF SULFAMIC ACID IN SULFURIC ACID SOLUTIONS AT 30°
(Cupery, 1938)

% H_2SO_4	Gms. HSO_3NH_2 per 100 gms. H_2SO_4 Solution	% H_2SO_4	Gms. HSO_3NH_2 per 100 gms. H_2SO_4 Solution
0.0	26.09	81.17	0.18
23.91	4.14	96.31	0.25
47.53	1.06	Fuming (21.1% SO_3)	2.38
71.80	0.00		

Se **HYDROGEN SELENIDE** H_2Se

Melting points in the system H_2Se + D_2Se were determined calorimetrically by Kruis, 1941.

He **HELIUM** He

The solubility of helium in water was reviewed by Lawrence, Loomis, etal. (1946), who drew an average curve through the results of Valentiner, 1927, 1930; Lannung, 1930; Cady, Elsey, and Berger, 1922; and Wiebe and Gaddy, 1935. The following data were read from the average curve:

Temperature°	0	5	10	15	20	25	30	35	40	60
cc H_2 (0°, 760mm) per cc of H_2O	0.0095	.0091	.0088	.0086	.0085	.0083	.0082	.0082	.0083	.0087

SOLUBILITY OF HELIUM IN OLIVE OIL

0.015 cc of helium (0°, 760 mm) dissolve in 1 cc of olive oil at 22° and at 37°. Behnke and Yarbrough, 1938).

Van Slyke, 1939, using an unanalyzed sample of gas, found that helium was only about 1½ times as soluble in olive oil as in water.

SOLUBILITY OF HELIUM IN LIQUID NITROGEN

(Gonikberg and Fastovskii, 1940a)

Pressure Kg/cm²	Mole % He		Pressure Kg/cm²	Mole % He	
	Liquid	Vapor		Liquid	Vapor
	78.0°K			90.1°K	
1.1	0.0	0.0	187	5.6	93.1
18.5	0.5	92.1	220	6.2	94.1
44.5	0.9	94.6	253	7.0	94.4
68	1.5	96.5	285	7.9	94.5
105	2.2	96.9			
147	2.6	97.8		109°K	
208	3.7	98.4			
269	4.6	98.3	13.3	0.0	0.0
295	5.0	-	27.5	2.3	45.5
			44.5	3.5	58.3
	90.1°K		81	6.2	66.3
			112	8.2	70.5
3.5	0.0	0.0	139	10.6	75.5
20.7	0.6	73.3	180	13.1	76.6
35.1	1.1	82.9	232	15.9	79.7
59	2.1	88.7	249	16.7	81.4
95	3.5	90.2	286	18.3	82.5
157	4.9	92.3			

The liquid-vapor equilibrium of the system helium-nitrogen at 68°, 77.3°, 90.1°, 107°, and 111.5°K and 200 - 250 atm. pressure is given by Kharakhorun, 1940.

SOLUBILITY OF HELIUM IN LIQUID METHANE

(Gonikberg and Fastovskii, 1940)

90.3°K		106°K	
Pressure Kg/cm²	Mole % He	Pressure Kg/cm²	Mole % He
30	0.13	26	0.19
78	.27	61	.39
98	.32	100	.63
116	.37	149	.90
139	.46	160	.97
162	.52		

SOLUBILITY OF HELIUM IN MELTS

(Gerling, 1940)

Each sample was fused in an atmosphere of helium and held at the temperature indicated for 30 minutes and then cooled, transferred to another vessel and the volume of the liberated helium measured. Each value was corrected for the solubility of helium in the quartz vessels used.

t°	Solvent	Pressure He mm	Solubility (mm³ He at 0°, 760mm dissolved in 1 gm. of Melt)
1300	KCl	698	1.13
1300	Gabbrodiabase	513	1.77
900	"	646	1.93 (held at 900° for 24 hours)
1300	"	716	2.68

Hf HAFNIUM Hf

Fischer and Chalybaeus, 1947 report attempts to separate mixtures of hafnium and zirconium compounds by partition between water and ether solutions. Mixed zirconium and hafnium oxysulfates (containing 0.5% HfO_2) were dissolved in a water solution of NH_4SCN and this mixture was then shaken with ether solutions containing 0.4 - 1.6 N HSCN. The results using different preparations of the salts, concentrations in the water and ether solutions, volumes, and numbers of extractions are reported.

Br MERCURIC BROMIDE $HgBr_2$

Correction to the third Edition, Volume I:

p. 611, Top, "Distribution of $HgBr_2$ between H_2O and C_6H_6" Divide all six values under "C_6H_6 layer" by 10.

EQUILIBRIUM IN THE SYSTEM MERCURIC BROMIDE - SODIUM BROMIDE - WATER AT 15°
(Contet, 1943)

The system was studied at 8° and 15° and the results were presented as diagrams only. The shape of the curve at each temperature is about the same. The results below (15°) were read from the diagrams. The results at 8° could not be read with sufficient accuracy to be included.

Gms. per 100 gms. Sat. Sol.		
NaBr	$HgBr_2$	Solid Phase
10	23	$HgBr_2$
20	53	"
22	60	$HgBr_2 + 2HgBr_2 \cdot NaBr \cdot 2H_2O$
22.5	60	$2HgBr_2 \cdot NaBr \cdot 2H_2O + HgBr_2 \cdot NaBr \cdot 2H_2O$
28	54	$HgBr_2 \cdot NaBr \cdot 2H_2O + NaBr$
30	52	$NaBr + NaBr \cdot 2H_2O$
35	30	$NaBr \cdot 2H_2O$

SOLUBILITY OF MERCURIC BROMIDE IN ORGANIC SOLVENTS AT 25°
(Semenchenko and Shakparonov, 1948)

Solvent	Moles $HgBr_2$ per 100 moles Sat. Sol.	Solvent	Moles $HgBr_2$ per 100 moles Sat. Sol.
$CH_3COOC_2H_5$	0.0388	C_2H_5OH	0.037
C_2H_5N	.070	CH_3OH	.058
Iso - C_4H_5OH	.013	Glycerin	.031
C_3H_5OH	.028		

CH MERCURIC ACETATE $Hg(C_2H_3O_2)_2$

0.186 grams $Hg(C_2H_3O_2)_2$ dissolve in 100 gms. of ethylene diamine
17.8 " " " " " " ethylene glycol

$Hg(C_2H_3O_2)_2$ decomposes when dissolved in monoethanol amine.

Isbin and Kobe, 1945.

CN

MERCUROUS CYANIDE HgCN

One liter of a saturated solution in water at 25° contains 8.1×10^{-14} gms. HgCN. (Kryukova, 1939).

MERCURIC CYANIDE

SOLUBILITY IN WATER AND DEUTERIUM OXIDE AT 5.0°

(Noonan, 1948)

The solubility of $Hg(CN)_2$ was determined in ordinary water and in water containing 91.43% deuterium oxide. These data were then extrapolated to obtain the solubility in pure deuterium oxide.

	H_2O (Ordinary water)	91.43% D_2O	100% D_2O
Moles $Hg(CN)_2$ per 100 moles Solvent	0.537	0.434	0.424

SOLUBILITY OF MERCURIC CYANIDE IN ORGANIC SOLVENTS

(Semenchenko and Shakparonov, 1948)

t°	Solvent	Moles $Hg(CN)_2$ per 100 moles Sat. Sol.	t°	Solvent	Moles $Hg(CN)_2$ per 100 moles Sat. Sol.
25	$CH_3COOC_2H_5$	0.006	25	CH_3OH	0.039
18	C_2H_5N	.169	18	CH_3CN	.015
25	C_3H_7OH	.010	15.5	Glycerin	.090
25	C_2H_5OH	.017	25	H_2O	.008
18	C_6H_5CN	.010			

MERCUROUS THIOCYANATE HgCNS

CNS

One liter of a saturated solution in water at 25° contains 2.7×10^{-7} gms. HgCNS. (Kryukova, 1939).

MERCUROUS CARBONATE Hg_2CO_3

CO

One liter of a saturated solution in water at 25° contains 8.8×10^{-9} gms. Hg_2CO_3. (Kryukova, 1939).

MERCUROUS CHLORIDE HgCl

Cl

Ferry and Riley, 1946 calculated the solubility of HgCl in Sea water to be 0.0000003 gms. per cc. at 25° (pH = 8.1).

MERCURIC CHLORIDE $HgCl_2$

Cl

Correction to Third Edition, Volume I: p. 622 Bottom:

"Solubility of $HgCl_2$ in Aqueous Hydrochloric Acid Solutions"

Columns 1 & 2 should read: Mg. Mols. HCl and ½$HgCl_2$ per 10 cc.

Column 4 (Gms. $HgCl_2$ per 100 cc. Sol.) Incorrect from line 2 to line 7

Complete column should read: 13.11, 26.85, 48.2, 75.5, 93.5, 98.4, 116, 120, 129.2.

SOLUBILITY OF MERCURIC CHLORIDE IN WATER AND DEUTERIUM OXIDE

(Eddy and Menzies, 1940)

The authors used small closed vessels containing about one gram of solvent. The D_2O was 99.4% pure, as determined from its melting point. Including corrections for the volume of solvent in the vapor phase, the authors estimate the accuracy of the results as 1%. The authors plotted their experimental points and read the following data from the curve. The original data are in terms of moles of salt per 55.51 mols. of solvent.

t°	Gms. $HgCl_2$ per 100 gms.		t°	Gms. $HgCl_2$ per 100 gms.	
	H_2O	D_2O		H_2O	D_2O
0	4.66	2.44	55	15.11	10.40
5	5.00	2.93	60	17.37	12.10
10	5.43	3.42	65	20.04	13.90
15	5.97	3.91	70	23.15	15.90
20	6.59	4.39	75	26.7	18.26
25	7.30	4.93	80	30.9	21.1
30	8.14	5.52	85	35.95	24.55
35	9.09	6.18	90	41.9	28.7
40	10.20	6.94	95	48.9	33.6
45	11.56	7.84	100	58.3	39.95
50	13.19	8.95	105	73.4	49.2

Cl THE SOLUBILITY OF MERCURIC CHLORIDE IN AQUEOUS CHLORIDE SOLUTIONS AT 25°

(Thomas, 1939)

The author read the following solubilities from a large-scale plot of his data at various concentrations. The original data are also given, and many points were determined at each curve.

Moles $[Cl^-]$ from added Salt per 1000 gms. H_2O	HCl		LiCl		$CaCl_2$	
	Moles $HgCl_2$ per 1000 gms. H_2O	d_4^{25}	Moles $HgCl_2$ per 1000 gms. H_2O	d_4^{25}	Moles $HgCl_2$ per 1000 gms. H_2O	d_4^{25}
0.0	0.2702	1.0563				
0.1	.376	1.0801	.375	1.0801	0.375	1.0821
.2	.481	1.1035	.475	1.1031	.478	1.1074
.3	.586	1.1266	.572	1.1257	.573	1.1318
.5	.795	1.1728	.761	1.1684	.762	1.1788
1.0	1.325	1.2823	1.230	1.2693	1.239	1.2907
2.0	2.420	1.4814	2.177	1.4516	2.207	1.4960
3.0	3.557	1.6598	3.145	1.6169	3.185	1.6805
4.0	4.726	1.8253	4.134	1.7661	4.164	1.8429
5.0	5.901	1.9774	5.132	1.9003	5.144	1.9878
6.0	7.054	2.1101	6.131	2.0206	6.123	2.1111
7.0	8.176	2.2261	7.120	2.1287		
8.0	9.264	2.3283	8.097	2.2251		
9.0	10.309	2.4193				

Moles $[Cl^-]$ from added Salt per 1000 gms. H_2O	$AlCl_3$		$LiCl - CaCl_2$*		$LiCl - AlCl_3$**	
	Moles $HgCl_2$ per 1000 gms. H_2O	d_4^{25}	Moles $HgCl_2$ per 1000 gms. H_2O	d_4^{25}	Moles $HgCl_2$ per 1000 gms. H_2O	d_4^{25}
0.1	0.373	1.0816	0.376	1.0795	0.375	1.0798
.2	.471	1.1057	.478	1.1026	.475	1.1030
.3	.568	1.1293	.576	1.1256	.572	1.1263
.5	.758	1.1753	.763	1.1708	.762	1.1714
1.0	1.235	1.2864	1.233	1.2790	1.231	1.2781
2.0	2.196	1.4899	2.188	1.4767	2.189	1.4715
3.0	3.175	1.6762	3.162	1.6515	3.158	1.6457
4.0	4.132	1.8419	4.145	1.8071	4.133	1.8013
5.0	5.044	1.9848	5.132	1.9449	5.104	1.9418
6.0			6.121	2.0695		
7.0			7.111	2.1816		

* $LiCl:CaCl_2 = 2.0013$ ** $LiCl:AlCl_3 = 2.9990$

0.4 gms. $HgCl_2$ dissolve in 100 gms. of ethylene diamine at 25°.
Isbin and Kobe, 1945.

0.2 gms. $HgCl_2$ dissolve in 1 cc. of sea water of pH = 8.1 at 25°.
Ferry and Riley, 1946.

1 part of $HgCl_2$ is soluble in 13 parts of Isopropyl alcohol.

1 part of $HgCl_2$ is soluble in 3.7 parts of C_2H_5OH denatured with methanol, pyridine, and mineral naphtha (mineralized methylated spirit).
Stout, 1945

Basic MERCURIC CHLORIDE C1

SOLUBILITY OF BASIC MERCURIC CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 25°
(Garrett and Lemley, 1942)

HCl concentrations are initial values. The solid phase was $2HgO \cdot HgCl_2$.

Gm. moles per 1000 gms. H_2O			Gm. moles per 1000 gms. H_2O	
HCl	HgO		HCl	HgO
0.0	0.00114	(average of 19	0.01002	0.00878
.00200	.0025	determinations)	.03003	.0238
.00300	.00325		.0501	.0385
.00500	.0049		.0801	.0626
.00701	.00622		.1008	.0760
.00801	.00684			

MERCURIC Choline CHLORIDE $(CH_3)_2NClC_2H_4CH \cdot HgCl_2$ C1

0.4 gms. are dissolved in 100 ml. of solution in water at room temperature. (Seaman, Hugonet, and Leibmann, 1949).

MERCURIC IODIDE HgI_2 I

SOLUBILITY OF RED MERCURIC IODIDE IN WATER AT 25°
(deBruijn, 1941)

The author approached equilibrium from higher and from lower temperatures, and determined the amount of mercury in solution by adding ammonium sulfide and comparing the solution with a standard solution in a colorimeter. The result was 44 mg. HgI_2 per liter of water at 25°.

47.7 mg. of red mercuric iodide are dissolved in one liter of water at 25°. (Biedermann and Sillen, 1949).

I' EQUILIBRIUM IN THE SYSTEM MERCURIC IODIDE - RUBIDIUM IODIDE - WATER AT 34°

(Pernot, 1940)

The data were given in the form of diagrams only, from which the following values were read.

Gms. RbI per 100 gms. Sat. Sol.	Gms. HgI_2 per 100 gms. Sat. Sol.	Solid Phase	Gms. RbI per 100 gms. Sat. Sol.	Gms. HgI_2 per 100 gms. Sat. Sol.	Solid Phase
5.0	4.0	$HgI_2 \cdot RbI \cdot H_2O$	44.7	43.7	3:5
10.0	10.7	"	45.5	44.0	3:5 + RbI
20.0	24.3	"	47.0	40.0	RbI
30.0	36.3	"	51.0	30.0	"
40.0	46.0	"	54.7	20.0	"
41.0	47.0	$HgI_2 \cdot RbI \cdot H_2O$ + $3HgI \cdot 5RbI$	59.0	10.0	"
			64.0	0.0	"
43.0	44.7	3:5			

IO MERCUROUS IODATE $HgIO_3$

At 25°, 6.0×10^{-7} gms. $HgIO_3$ are dissolved in one liter of saturated aqueous solution. (Kryukova, 1939).

O MERCURIC OXIDE HgO

SOLUBILITY OF YELLOW MERCURIC OXIDE IN HYDROCHLORIC ACID SOLUTIONS AT 25°

(Garrett and Lemley, 1942)

The authors found that the compound $2HgO \cdot HgCl_2$ formed in solutions containing over 0.007 moles HCl/1000 gms. of H_2O. From 0.007 M to 0.08 M the solubility is nearly constant (two phases?), and above this concentration of HCl the solubility increases rapidly (solid phase $2HgO \cdot HgCl_2$). Since the yellow HgO changed to black $2HgO \cdot HgCl_2$, the phase change could be roughly followed by the color changes. Two sets of data are presented which agree fairly well up to 0.08 M in HCl, but which differ from each other by a nearly constant 0.05 moles/1000 gms. H_2O at higher concentrations of HCl. The authors' data were plotted, and the following values read from the average curves. In the range above 0.08 M HCl the higher set of values are given since they are identical with the solubility of $2HgO \cdot HgCl_2$ when the HCl needed to form the compound is subtracted from the total amount present.

Gm. moles per 1000 gms. H_2O		Probable Solid Phase	Gm. moles per 1000 gms. H_2O		Probable Solid Phase
HCl (initial)	HgO		HCl (initial)	HgO	
0.001	0.0008	HgO (Yellow)	0.007 - 0.09	0.0019	HgO (Yellow)+ $2HgO \cdot HgCl_2$ (Black)
.002	.0013	"			
.003	.0017	"	0.100	.0082	$2HgO \cdot HgCl_2$ (Black)
.004	.0022	"	.121	.0237	"
.005	.0027	"	.141	.0387	"
.006	.0031	"	.161	.0545	"
.007	.0036	"	.202	.0880	"
.008	.0041	"	.243	.1150	"
.009	.0047	"	.283	.1410	"
.010	.0052	"			

Data for the amount of HCl remaining in solution after reaction is also given.

O

One liter of 49.8% NaOH (18.8 N) at 142° (boiling point) dissolves 2.1 gms. HgO.

Ferry and Riley (1946), calculate that 0.08 gms. HgO dissolve in 1 cc. of sea water of pH = 8.1 at 25°.

MERCUROUS HYDROXIDE HgOH

OH

One liter of a saturated solution in water at 25° contains 5.2×10^{-9} gms. HgOH. (Kryukova, 1939).

Oka, 1940 found the solubility of mercurous hydroxide in water to be 4.2×10^{-7} moles per liter.

MERCURIC HYDROXIDE $Hg(OH)_2$

OH

Oka, 1940 found the solubility of mercuric hydroxide in water to be about 4×10^{-3} moles per liter.

PHENYL MERCURY HYDROXIDE $HgC_6H_6(OH)$

OH

SOLUBILITY IN SODIUM HYDROXIDE SOLUTIONS AT 0°
(Schramm, 1947)

Normality of NaOH	Gms. $HgC_6H_6(OH)$ per 100 cc.
0.0	0.52
.0185	.48
1	.36

MERCUROUS Meta PHOSPHATE $HgPO_3$

PO

One liter of a saturated solution in water contains 3.5×10^{-7} gms. $HgPO_3$ at 25°. (Kryukova, 1939).

MERCUROUS SULFIDE Hg_2S

S

One liter of a saturated solution in water at 25° contains 2.8×10^{-23} gms. Hg_2S. (Kryukova, 1939).

MERCURIC SULFIDE HgS

S

SOLUBILITY IN WATER AND PERCHLORIC ACID SOLUTION

Treadwell and Schaufelberger (1946) calculate the thermodynamic solubility product to be 0.3×10^{-51}. A 1 N solution of $HClO_4$ which is saturated with H_2S dissolves 3.3×10^{-7} moles of HgS per liter at 18°.

SO MERCUROUS SULFITE Hg_2SO_3

One liter of a saturated solution in water at 25° contains 1.5×10^{-11} gms. Hg_2SO_3. (Kryukova, 1939).

SO MERCUROUS THIOSULFATE $Hg_2S_2O_3$

One liter of a saturated solution in water at 25° contains 2.2×10^{-15} gms. $Hg_2S_2O_3$. (Kryukova, 1939).

I IODINE I_2

SOLUBILITY OF IODINE IN HYDRIODIC ACID SOLUTIONS AT 25°
(Powell and Campbell, 1947)

Highly purified reagents were used, and sampling was done in an atmosphere of helium. The authors estimate their accuracy as 1%.

Original Solvent		Saturated Solution			Kg. I_2 per liter of Solvent	Kg. I_2 per 1000 gms. of Solvent
% HI	d_4^{25}	% HI	% I_2	d_4^{25}		
66.7	1.946	18.1	72.85	3.28	5.22	2.68
64.0	1.877	18.2	71.55	3.22	4.72	2.52
54.4	1.644	17.5	67.8	-	3.47	2.11
50.2	1.557	17.8	64.6	-	2.84	1.825
45.9	1.486	18.1	60.5	-	2.28	1.532

The solubility of iodine in aqueous HCl solutions at 25°, 35°, and 45° is reported by Lee and Chen, 1937.

The solubility of iodine in aqueous HBr solutions at 15° and 45° is reported by Lee and Lee, 1936. The solubility curve is linear in solutions containing up to 3 M HBr.

Tsing-Lien Chang (1944) found the distribution of iodine between CCl_4 and D_2O to be 103:1 at 25°, compared with 85:1 for CCl_4 and H_2O at the same temperature.

SOLUBILITY OF IODINE IN ORGANIC SOLVENTS
(Benesi and Hildebrand, 1948)

Solvent	Grams per 100 grams of Saturated Solution		
	15°	25°	35°
Ethylene Chloride	3.912	5.44	7.39
Ethylidene Chloride	-	3.826	5.245
cis-Dichloroethylene	2.597	3.686	5.173
trans-Dichloroethylene	-	3.628	5.048
Perfluoro-n-Heptane	-	0.0120	-

Data for the solubility of iodine in several non-polar solvents are given by Negisi, 1940.

MELTING POINTS IN THE SYSTEM PHOSPHORUS PENTABROMIDE - IODINE

(Kuzmenko and Fialkov, 1949)

Mole % PBr_5	Melting Point°	Mole % PBr_5	Melting Point°	Mole % PBr_5	Melting Point°	Mole % PBr_5	Melting Point°
0.0	113.2	26.3	70.9	45.0	20.2	74.7	109.5
4.5	103.8	28.1	66.5	49.3	13.5	75.8	110.1
7.1	99.0	28.6	65.5	50.0	13.5*	78.2	108.2
10.6	93.0	30.4	63.0	50.4	13.5	80.2	110.0
14.2	87.0	33.2	56.0	53.1	17.5	84.3	108.0
14.9	85.0	36.3	48.0	57.9	39.0	89.0	110.5
20.1	81.5	37.6	38.5	65.7	94.0	90.0	109.4
22.1	79.5	40.5	32.0	69.1	105.0	100.0	103.7
26.2	71.0	41.2	28.2	72.4	107.0		

* Eutectic

MELTING POINTS OF IODINE WITH PHOSPHORUS HALIDES

(Pialkov and Kuzmenko, 1949)

$PBr_3 + I_2$

Mole % PBr_3	Melting Point	Mole % PBr_3	Melting Point
0.0	113.2	67.9	65.4
12.6	103.7	73.3	58.7
21.3	97.2	77.8	52.2
30.0	93.5	81.7	45.0
37.1	88.8	84.6	36.5
45.2	85.5	86.7	30.0
50.0	80.6	88.7	26.0
57.2	74.7	90.8	17.5
63.4	68.4	96.2	-5.0

$P_2I_4 + I_2$

Mole % P_2I_4	Melting Point	Mole % P_2I_4	Melting Point
0.0	113.3	27.1	46.5
1.1	111.5	31.5	38.0
4.7	104.2	34.3*	33.0
6.4	101.1	36.8	36.1
7.1	99.0	39.8	43.0
8.4	96.0	44.5	49.0
10.2	93.0	46.3	52.0
12.3	87.8	50.3	61.0
14.3	83.4	58.5	79.5
17.7	75.0	65.0	91.5
20.1	69.0	67.4	99.0
21.0	64.5		

* Eutectic

$PCl_3 + I_2$

Mole % PCl_3	Melting Point
0.0	113.1
3.8	111.5
12.1	108.4
22.3	104.3
33.0	102.3
37.6	102.1
58.8	102.1

$PCl_5 + I_2$

Mole % PCl_5	Melting Point	Mole % PCl_5	Melting Point	Mole % PCl_5	Melting Point
0.0	113.2	36.4	90.0	52.9	118.2
10.1	105.0	39.5	92.1	53.1	122.0
18.1	97.5	44.5	101.5	57.5	136.0
28.4	82.0	47.8	106.5	65.3	163.0
31.8	80.5	50.4	112.5	70.0	187.0
33.9	79.5*	52.2	116.5	74.0	198.0

* Eutectic

The surface tensions and densities of solutions of sulfur, iodine, and selenium in carbon disulfide at 12°, 17°, and 25° have been accurately determined by Kapustinsky and Golutvin, 1947. The following systems were studied: S + CS_2, I + CS_2, S + I + CS_2, Se + I + CS_2, S + Se + CS_2 in solutions containing 0 - 0.05 gm. atoms of solute per liter.

Melting points in the systems I + SbI_3 and I + AsI_3 are given by Montignie, 1941.

Br IODINE MONOBROMIDE IBr

The viscosities and conductivities in the systems IBr + KI and IBr + KBr were determined by Fialkov and Goldman, 1941.

The conductivities and other physical properties in the system IBr + KBr + Nitrobenzene were determined by Fialkov and Shor, 1949.

Cl IODINE MONOCHLORIDE ICl

SOLUBILITY OF IODINE MONOCHLORIDE IN SOLUTIONS OF ACETIC ACID AND CARBON TETRECHLORIDE AND VICE VERSA

(Cornog and Olson, 1940)

ICl + CH_3COOH form a simple system. ICl + CCl_4 form solid solutions and the liquidous is "s" shaped. A wholly metastable liquid immiscibility gap was also found.

ICl + CH_3COOH			ICl + CCl_4		
t°	Mole % CH_3COOH	Solid Phase	t°	Liquid Phase Mole % CCl_4	Solid Phase Mole % CCl_4
27.3	0.0	ICl	27.3	0.0	
26.0	4.9	"	26.0	2.0	
25.0	7.3	"	25.0	3.9	
23.0	12.8	"	23.1	-	0.85
20.0	17.8	"	23.0	9.4	
19.0	19.6	"	22.0	15.1	
17.0	24.0	"	21.0	24.3	
15.0	26.7	"	20.5	43.2	
10.0	34.3	"	20.0	54.0	
0.1	42.1	"	19.0	64.6	
-18.2	53.2	"	18.8	-	4.1
-35.5	60.0	ICl + CH_3COOH	17.0	73.2	
-18.2	68.4	CH_3COOH	15.0	78.4	
0.1	82.2	"	10.2	-	15.3
10.2	91.3	"	10.0	85.2	
16.4	100.0	"	0.1	90.7	29.3
			0.0	90.7	
			-8.0	93.2	38.5
			-15.7	95.3	
			-25.5	98.7 Eutectic	
			-26.4	98.2 "	

	Upper Liquid Layer	Lower Liquid Layer	
0.0	76.2	15.3	Meta-
10.0	65.6	29.5	stable

Melting point data are given for the following:

ICl + Pyridine (Fialkov and Muzyka, 1948)
$ICl + C_6H_5CONH_2$ (Fialkov and Muzyka, 1949)

The following systems have been studied:

$ICl + I$	Conductivity	Fialkov and Goldman (1941)	
$ICl + AlBr_3$	"	" " " "	
$ICl + KBr$	" and Viscosity	" " " "	
$ICl + KI$	" " "	" " " "	
$ICl + KCl$	" and Density	Fialkov and Shor (1949a)	
$ICl + AlCl_3$	" " "	" " " "	
$ICl + C_6H_5NO_2$	" and Transport numbers	"	Fialkov and Kazanskaya (1948)
$ICl + C_6H_5NO_2 + KCl$	" " "	"	
$ICl + C_6H_5NO_2 + AlCl_3$	" " "	"	

INDIUM BROMIDE $InBr_3$ Br

SOLUBILITY IN WATER
(Bnsslin, Ziemeck, and Schaepdryver, 1947)

t°	Gms. $InBr_3$ per 100 gms. Sat. Sol.	Density d_{20}^{t}	Solid Phase	t°	Gms. $InBr_3$ per 100 gms. Sat. Sol.	Density d_{20}^{t}	Solid Phase
0	71.26	2.3815	$InBr_3 \cdot 5H_2O$	25.5	85.10	2.8399	$InBr_3 \cdot 2H_2O$
2	71.66	2.3880	"	29	85.19	2.8562	"
4	72.53	2.3977	"	29.5	85.35	2.8569	"
14	74.51	2.4636	"	34.5	85.19	2.8734	$InBr_3$
16	75.62	2.4770	"	40	85.53	2.8742	"
18	76.71	2.5550	"	50	85.75	2.8988	"
19	79.94	2.6145	"	60	86.09	2.9026	"
20	80.55	2.6715	"	70	86.49	2.9027	"
22	84.64	2.8362	?	100	87.48	2.8932	"
22	85.26	2.8340	$InBr_3 \cdot 2H_2O$	105	87.91	2.8991	"
23	85.13	2.8348	"				

SOLUBILITY OF INDIUM BROMIDE IN HYDROBROMIC ACID SOLUTIONS AT 24°
(Bnsslin and Dreyer, 1942)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
$InBr_3$	HBr		
84.27	0.0	2.836	$InBr_3$
73.6	10.9	2.786	"
71.8	12.5	2.716	"

SOLUBILITY OF INDIUM BROMIDE IN ORGANIC SOLVENTS AT 20°

(Ensslin and Lessmann, 1947)

Solvent	Gms. $InBr_3$ per 100 gms. Sat. Sol.	Density	Solvent	Gms. $InBr_3$ per 100 gms. Sat. Sol.	Density
Benzene	0.48	0.883	Chloroform	3.10	1.497
1.2 Dichlorethylene	2.31	1.269	Methyl Alcohol	74.08	2.014
Ethylene Glycol	61.59	2.137	Ethyl Alcohol	73.31	2.215
Glycerin	7.00	1.205	Amyl Alcohol	49.37	1.352
Ethyl Acetate	60.00	1.680	Acetone	72.33	1.902
Amyl Acetate	56.16	1.550	Ether	71.44	1.807

Not soluble in petroleum ether or carbon tetrachloride.

Br

100 gms. of a saturated solution of indium bromide in alcohol contains 163.9 gms. $InBr_3$ at 20° (density = 2.215). The solid phase is $InBr_3$.

Ensslin and Dreyer, 1942

EQUILIBRIUM IN SOLUTIONS OF INDIUM BROMIDE AND OTHER BROMIDES

(Ensslin, Ziemeck, and Schaepdryver, 1947)

The authors prepared various solutions and evaporated them at room temperature over phosphorous pentoxide. The crystals were separated from their saturated solutions, and both were analyzed.

Gms. $InBr_3$ per 100 cc Sat. Sol.	Gms. Added Salt per 100 cc Sat. Sol.	Solid Phase
With Magnesium Bromide		
165.3	31.1	$MgBr_2 \cdot 2InBr_3 \cdot 7H_2O$
155.1	37.8	"
92.7	61.1	$MgBr_2 \cdot InBr_3 \cdot 7H_2O$
85.9	62.8	"
77.8	65.9	"
76.6	67.4	"
63.9	74.7	$MgBr_2 \cdot 6H_2O$
44.9	83.0	"
With Strontium Bromide		
179.5	14.1	$SrBr_2 \cdot 2InBr_3 \cdot 9H_2O$
165.3	28.2	"
162.5	29.4	"
159.1	29.5	"
149.8	37.8	"
141.2	40.1	"
140.0	42.4	$SrBr_2 \cdot InBr_3 \cdot 10H_2O$
126.0	45.7	"
124.8	47.2	$2SrBr_2 \cdot InBr_3 \cdot 16H_2O$
105.3		$SrBr_2$ aq.
With Zinc Bromide		
102.9	127.8	$3ZnBr_2 \cdot 4InBr_3 \cdot 14H_2O$
87.7	140.2	"
64.9	164.6	"
56.2	175.0	$3ZnBr_2 \cdot InBr_3 \cdot 4H_2O$

Gms. $InBr_3$ per 100 cc Sat. Sol.	Gms. Added Salt per 100 cc Sat. Sol.	Solid Phase
With Calcium Bromide		
184.4	17.0	$CaBr_2 \cdot 2InBr_3 \cdot 8H_2O$
180.1	20.0	"
80.3	58.0	$CaBr_2 \cdot InBr_3 \cdot 8H_2O$
76.9	76.5	"
61.8	78.0	"
53.4	82.2	"
47.3	83.4	$3CaBr_2 \cdot 2InBr_3 \cdot 23H_2O$
39.8	85.3	"
29.0	90.8	$2CaBr_2 \cdot InBr_3 \cdot 14H_2O$
26.4	93.8	"
With Lithium Bromide		
71.7	65.1	$3LiBr \cdot InBr_3 \cdot 8H_2O$
59.3	73.8	"
14.2	93.9	"
With Thallium Bromide		
176	0.42	$TlBr \cdot InBr_3 \cdot 3H_2O$
243	0.52	"

There are no double salts formed in the system $InBr_3 + BaBr_2 + H_2O$

INDIUM OXINE $In(C_9H_6NO)_3$ CH

The solubility product $K = [In^{+3}] [C_9H_6NO^-]^3$ at 18° is $K = 2 \times 10^{-37}$.

One liter of a saturated solution of $In(C_9H_6NO)_3$ in chloroform at 18° contains 0.24 moles. - LaCroix, 1947.

INDIUM CHLORIDE $InCl_3$ Cl

SOLUBILITY OF INDIUM CHLORIDE IN WATER
(Ensslin, Ziemeck, and Schaepdryver, 1947)

t°	Gms. $InCl_3$ per 100 gms. Sat. Sol.	Density d_{20}^{t}	Solid Phase
2	62.50	1.8500	$InCl_3 \cdot 4H_2O$
14.5	65.44	1.9420	"
22	66.11	1.9736	"
24	67.92	2.0192	"
26	69.62	2.0333	"
31	71.12	2.0828	"
35	73.07	2.1166	"
30.5	69.85	2.0592	$InCl_3 \cdot 3H_2O$
41	71.7	2.085	"
51	73.31	2.1702	"
60	75.34	2.2000	"
70	77.71	2.2278	"
75	78.3	2.233	"
80	78.87	2.2506	$InCl_3 \cdot 2.5H_2O$
81	78.79	2.2549	"
85	79.23	2.2603	"
90	79.50	2.2662	"
94	80.27	2.2768	"
98	80.74	2.2834	"
105	81.33	2.2935	$InCl_3 \cdot 2H_2O$
110	81.35	2.2942	"
118	81.68	2.3069	"

At 22°, 100 gms. of a saturated solution in water contain 64.7 gms. $InCl_3$ (density = 1.960; Solid Phase $InCl_3 \cdot 4H_2O$.)

At 22°, 100 gms. of a saturated solution in absolute ethanol contain 53.2 gms. $InCl_3$ (density = 1.400; Solid Phase $InCl_3$).

At 22°, 100 gms. of a saturated solution in 3% HCl contain 59.5 gms. $InCl_3$.

(Ensslin and Dreyer, 1942)

EQUILIBRIUM IN SOLUTIONS OF INDIUM CHLORIDE WITH OTHER CHLORIDES
(Ensslin, Ziemeck, and Schaepdryver, 1947)

The authors prepared various solutions and evaporated them at room temperature over phosphorous pentoxide. The crystals were separated from the saturated solutions, and both were analyzed.

Gms. $InCl_3$ per 100 cc Sat. Sol.	Gms. Added Salt per 100 cc Sat. Sol.	Solid Phase
	With Magnesium Chloride	
131.8	13.3	$MgCl_2 \cdot 2InCl_3 \cdot 10H_2O$
112.0	18.0	"
109.0	22.7	$MgCl_2 \cdot InCl_3 \cdot 7H_2O$
73.4	36.4	"
64.6	38.0	"
53.0	43.1	$2MgCl_2 \cdot InCl_3 \cdot 2H_2O$
51.6	44.0	"
50.1	46.9	"
	With Calcium Chloride	
143.9	8.4	$InCl_3 \cdot 4H_2O$
135.3	10.8	$CaCl_2 \cdot 2InCl_3 \cdot 12H_2O$
127.6	13.6	$3CaCl_2 \cdot 4InCl_3 \cdot 30H_2O$
93.4	30.6	$CaCl_2 \cdot InCl_3 \cdot 8H_2O$
64.3	45.8	"
54.3	54.5	"
42.4	60.1	"
36.2	67.3	"
	With Strontium Chloride	
134.9	19.2	$SrCl_2 \cdot 2InCl_3 \cdot 8H_2O$
110.6	25.8	$SrCl_2 \cdot InCl_3 \cdot 6H_2O$
104.5	26.5	"
104.0	28.0	"
96.3	28.9	"
74.6	36.7	"
74.2	37.1	$SrCl_2 \cdot 6H_2O$
	With Lithium Chloride	
133.3	14.9	Hydrated Solid Solution $\frac{LiCl}{InCl_3} = 1.62$
126.0	15.3	" 1.78
114.5	17.9	" 2.36
106.9	16.1	" 2.36
101.4	22.7	" 2.43
100.6	23.6	" 2.43
89.8	18.9	$3LiCl \cdot InCl_3 \cdot 9H_2O$
24.9	46.7	"
20.0	51.7	"
12.9	55.7	"
9.6	58.6	LiCl
8.7	58.4	"
	With Zinc Chloride	
54.9	115.5	$ZnCl_2 \cdot 2InCl_3 \cdot 8H_2O$
48.2	125	$2ZnCl_2 \cdot InCl_3 \cdot 5H_2O$

Cl

The compound $InCl_3 \cdot TlCl \cdot 3H_2O$ is formed with Thallium Chloride, and no double salts are formed in the system $InCl_3 + BaCl_2 + H_2O$. The compound $3LiCl \cdot In_2S_3$ was prepared from solutions of the salts.

SOLUBILITY OF INDIUM CHLORIDE IN ORGANIC SOLVENTS AT 20°

(Ensslin and Lessmann, 1947)

Solvent	Gms. $InCl_3$ per 100 gms. Sat. Sol.	Density	Solvent	Gms. $InCl_3$ per 100 gms. Sat. Sol.	Density
Chloroform	1.52	1.517	Glycerin	1.57	1.220
Methyl Alcohol	51.16	1.406	Ethyl Acetate	38.25	1.247
Ethyl Alcohol	36.20	1.16	Amyl Acetate	26.20	1.084
Amyl Alcohol	23.02	0.996	Acetone	37.97	1.142
Ethylene Glycol	25.17	1.495	Ether	35.18	0.967

Not soluble in petroleum ether, benzene, 1,2 dichlorethylene, or carbon tetrachloride.

Melting points in the systems $InCl_3$ + AgCl, $InCl_3$ + $CdCl_2$, $InCl_3$ + NaCl, $InCl_3$+ $PbCl_2$, and $InCl_3$ + $ZnCl_2$ are given by Vovkogon and Fialkov, (1945).

INDIUM Cobalt Hexammine CHLORIDE $[Co(NH_3)_6]InCl_6$ Cl

	$[Co(NH_3)_6]InCl_6$
One liter of saturated solution in water at 20° contains	10.1 gms.
" " " " " " 5% NH_4Cl " "	0.11 " "
" " " " " " 5% HCl " "	0.067 " "

- Ensslin and Dreyer, 1942

INDIUM FLUORIDE InF_3 F

SOLUBILITY IN WATER

At 22°, 7.83 gms. InF_3 are contained in 100 gms. of saturated solution in water (density = 1.070: solid phase $InF_3 \cdot 3H_2O$)(Ensslin and Dreyer, 1942).

At 25°, 8.64 gms. of InF_3 are contained in 100 ml. of saturated solution in water. (Thiel, 1904).

SOLUBILITY OF INDIUM FLUORIDE IN ORGANIC SOLVENTS AT 20°

(Ensslin and Lessmann, 1947)

Solvent	Gms. InF_3 per 100 gms. Sat. Sol.	Density	Solvent	Gms. InF_3 per 100 gms. Sat. Sol.	Density
Methyl Alcohol	0.89	0.813	Glycerin	0.03	1.223
Ethyl Alcohol	.02	.825	Ethyl Acetate	.02	0.914
Amyl Alcohol	.006	.810	Amyl Acetate	.005	0.870
Ethylene Glycol	.27	1.15	Acetone	Trace	-

Not soluble in petroleum ether, benzene, chloroform, carbon tetrachloride, 1, 2 dichlorethylene, or ether.

UM Sodium FLUORIDE Na_3InF_6

23°, 100 gms. of a saturated solution in water contain 8.33 gms. InF_6 (density = 1.0175) (Ensslin and Dreyer, 1942).

UM IODIDE InI_3

SOLUBILITY OF INDIUM IODIDE IN WATER
(Ensslin, Ziemeck, and Schaepdryver, 1947)

he solid phase was anhydrous InI_3 throughout. The results do not lie smooth curve.

t°	Gms. InI_3 per 100 gms. Sat. Sol.	Density	t°	Gms. InI_3 per 100 gms. Sat. Sol.	Density
	92.31	3.4492	40	94.23	3.4809
.5	92.35	3.4503	51	94.24	3.4982
	92.40	3.4522	61	94.48	3.5064
	92.91	3.4620	69	94.81	3.5273
	93.51	3.4687	70	95.29	3.5299

SOLUBILITY OF INDIUM IODIDE IN HYDRIODIC ACID SOLUTIONS
(Temperature not Given)
(Ensslin and Dreyer, 1942)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
InI_3	HI		
91.6	0	3.438	InI_3
87.2	2.1	3.398	"
80.6	4.7	3.026	"

SOLUBILITY OF INDIUM IODIDE IN ORGANIC SOLVENTS AT 20°
(Ensslin and Lessmann, 1947)

Solvent	Gms. InI_3 per 100 gms. Sat. Sol.	Density	Solvent	Gms. InI_3 per 100 gms. Sat. Sol.	Density
oleum Ether	0.41	0.723	Amyl Alcohol	58.29	1.566
ene	6.27	0.929	Ethylene Glycol	72.77	2.4603
roform	8.98	1.558	Glycerin	10.85	1.249
on Tetrachloride	Decomposes		Ethyl Acetate	78.35	2.351
Dichlorethy-lene	5.33	1.313	Amyl Acetate	73.75	2.096
yl Alcohol	86.64	2.706	Acetone	74.94	2.288
l Alcohol	84.37	2.687	Ether	85.50	2.248

EQUILIBRIUM IN SOLUTIONS OF INDIUM IODIDE AND OTHER IODIDES

(Rosslin, Ziemeck, and Schaepdryver, 1947)

The authors prepared various solutions and evaporated them at roo temperature over phosphorous pentoxide. The crystals were separate from their saturated solutions and both were analyzed.

Gms. InI_3 per 100 cc Sat. Sol.	Gms. Added Salt per 100 cc Sat. Sol.	Solid Phase
With Magnesium Iodide		
81.6	68.6	$MgI_2 \cdot 2InI_3 \cdot 11H_2O$
70.8	75.0	$3MgI_2 \cdot 4InI_3 \cdot 26H_2O$
22.5	89.0	$MgI_2 \cdot InI_3 \cdot 6H_2O$
20.0	96.1	"
11.4	107.1	"
9.7	106.4	$MgI_2 \cdot 6H_2O$
6.4	107.5	"
5.1	113,8	"
3.4	116.7	"
With Strontium Iodide		
120.9	74.8	$SrI_2 \cdot InI_3 \cdot 10H_2O$
102.3	79.3	"
95.0	80.6	"
93.2	81.0	"
59.1	96.2	"
13.0	115.7	"
9.5	118.8	$2SrI_2 \cdot InI_3 \cdot 18H_2O$
8.9	128.7	SrI_2 aq.
With Lithium Iodide		
123.0	48.2	$LiI \cdot InI_3 \cdot 4H_2O$
60.9	68.7	"
12.5	90.6	"
With Thallium Iodide		
10.3	0.1	$TlI \cdot 2InI_3 \cdot 3H_2O$
28.0	0.61	"

Gms. InI_3 per 100 cc Sat. Sol.	Gms. Added Salt per 100 cc Sat. Sol.	Solid Phase
With Calcium Iodide		
124.3	69.7	$CaI_2 \cdot InI_3 \cdot 8$
22.5	107.1	"
10.9	112.2	$2CaI_2 \cdot 3InI_3 \cdot 1$
3.8	117.9	$CaI_2 \cdot InI_3 \cdot 6H$
3.2	124.7	$CaI_2 \cdot aq$
1.6	131.5	"
With Barium Iodide		
230.1	22.3	InI_3
193.0	34.2	$BaI_2 \cdot 2InI_3 \cdot 1$
188.7	40.4	"
174.0	48.0	$BaI_2 \cdot InI_3 \cdot 5$
100.0	81.2	"
134.3	71.2	BaI_2 aq
132.6	73.2	"
With Zinc Iodide		
99.3	113.3	$2ZnI_2 \cdot 3InI_3 \cdot 1$
63.0	168.9	"
39.7	180.6	$ZnI_2 \cdot 3InI_3 \cdot 5$
33.5	191.3	"
23.9	208.0	"
28.5	218.7	$ZnI_2 \cdot aq$
26.4	221.8	"

INDIUM IODATE $In(IO_3)_3$

SOLUBILITY OF INDIUM IODATE IN NITRIC ACID SOLUTIONS AT 20°

(Rosslin, 1942-3)

Gms. HNO_3 per Liter of Sat. Sol.	Gms. $In(IO_3)_3$ per Liter of Sat. Sol.	Density
0.0	0.53	1.000
84	7.80	1.048
142	10.90	1.080
278	15.00	
376	14.69	1.20
515	11.10	1.25
704	6.02	1.33

IO **INDIUM per IODATE $InIO_5$**

Ensslin, Ziemeck, and Schaepdryver, 1947 report the preparation of the following compounds:

Gms. per 100 gms. Saturated Solution			Density	Solid Phase
$InIO_5$	$In(NO_3)_3$	HNO_3		
2.75	3.02	36.7	1.413	$3InIO_5 \cdot In(OH)_3$
6.80	6.25	29.9	1.391	"
0.85	27.3	36.5	1.600	$3InIO_5 \cdot HIO_4$
1.13g In	23.3g IO_4	10.4g SO_4	1.375	$4InIO_5 \cdot In(OH)_3 \cdot 5H_2O$

OH **INDIUM HYDROXIDE $In(OH)_3$**

SOLUBILITY IN WATER
(Moeller, 1941)

From titrations of indium sulfate, nitrate, and chloride solutions with sodium, potassium, and ammonium hydroxide solutions, the following results were obtained.

t°	Ksp	Gm. moles $In(OH)_3$ per liter
10	0.04×10^{-32}	1.1×10^{-9}
25	$.7 \times 10^{-32}$	2.3×10^{-9}
40	2.4×10^{-32}	3.0×10^{-9}

The salts were all assumed to be 100% dissociated, and slightly larger values were obtained from $InCl_3$ solutions than from the other two salts.

Oka, 1940 found the solubility of indium hydroxide in water to be 2.2×10^{-9} moles per liter.

S **INDIUM SULFIDE In_2S_3**

Ensslin, Ziemeck, and Schaepdryver, 1947 report the preparation of the following compounds:

$NaInS_2 \cdot 4H_2O$ from a saturated solution containing: 3.7 gms. Na_2S and 0.84 gms. In_2S_3 per 100 cc.

$NaInS_2 \cdot 3H_2O$ from a more concentrated solution.

$KInS_2 \cdot 4H_2O$ from a saturated solution containing 0.26 g In_2S_3 per 100 cc.

$LiInS_2 \cdot LiOH \cdot 9H_2O$ from a saturated solution containing 2.7 gms. In_2S_3 per 100 cc.

$4LiInS_2 \cdot 4LiOH \cdot LiCl \cdot 10H_2O$ from a saturated solution containing 1.8 g In_2S_3, 22.8 g Li_2S, and 32.5 g LiCl per 100 cc.

$LiInS_2 \cdot LiOH \cdot 2LiCl$ from a saturated solution containing 0.55 g In_2S_3, 40 g Li_2S, and 63.5 g LiCl per 100 cc.

$3LiCl \cdot In_2S_3$ from a saturated solution containing 0.048 gms. In_2S_3 and 27.3 g LiCl in 100 cc.

$3BaS \cdot Ba(OH)_2 \cdot 3In_2S_3 \cdot 16H_2O$ from a saturated solution containing 2.7 g $BaCl_2$ and 2.2 g BaS in 100 cc.

INDIUM SULFATE $In_2(SO_4)_3$ SO

SOLUBILITY OF INDIUM SULFATE IN SULFURIC ACID SOLUTIONS

(Ensslin, Lessman, and Ziemeck, 1947)

Each solution was analyzed for indium and for sulfate, and the amount of sulfuric acid present was calculated from the amount of sulfate in excess of that required to form $In_2(SO_4)_3$. In neutral or very weakly acid solutions, the solid phase is the basic salt $2In(OH)SO_4 \cdot 5H_2O$.

Gms. H_2SO_4 per 100 gms. Sat. Sol.	Gms. $In_2(SO_4)_3$ per 100 gms. Sat. Sol.	Density	Solid Phase
	Results at 20°		
3.6	51.19	1.754	$In_2(SO_4)_3 \cdot 10H_2O$
6.6	45.05	1.678	"
7.5	43.95	1.657	"
9.4	41.88	1.642	"
10.3	40.81	1.637	"
13.7	36.53	1.620	"
15.3	34.70	1.598	"
20.2	30.44	1.551	"
21.0	29.77	1.545	"
24.3	26.38	1.524	"
25.3	24.80	1.521	"
27.8	21.92	1.516	$In_2(SO_4)_3 \cdot 10H_2O$ + $In_2(SO_4)_3 \cdot H_2SO_4 \cdot 7H_2O$
28.2	21.58	1.512	$In_2(SO_4)_3 \cdot H_2SO_4 \cdot 7H_2O$
30.8	18.94	1.480	"
33.2	15.47	1.453	"
37.8	11.39	1.446	"
41.3	6.51	1.424	"
46.6	3.52	1.400	"
49.7	1.75	1.417	"
51.7	0.85	1.435	"
53.4	0.75	1.444	"
54.9	0.55	1.450	"
90.2	0.061	1.820	"
	Results at 40°		
4.15	53.44	1.735	$In_2(SO_4)_3 \cdot 10H_2O$
5.9	51.64	1.720	"
7.5	49.38	1.693	"
8.5	47.81	1.690	"
9.6	46.27	1.680	$In_2(SO_4)_3 \cdot 6H_2O$
10.5	45.84	1.678	$In_2(SO_4)_3 \cdot 10H_2O$
12.2	42.84	1.660	$In_2(SO_4)_3 \cdot 6H_2O$
14.1	40.59	1.631	"
15.1	39.24	1.621	"
17.0	36.53	1.614	"
18.7	34.05	1.604	"
20.5	32.20	1.580	"
21.3	30.67	1.562	"
23.4	27.51	1.555	"
26.9	23.22	1.510	"
29.9	20.55	1.492	"
32.0	18.24	1.486	"
33.6	15.60	1.466	
36.6	12.11	1.433	"

Gms. H_2SO_4 per 100 gms. Sat. Sol.	Gms. $In_2(SO_4)_3$ per 100 gms. Sat. Sol.	Density	Solid Phase
		Results at 40° Cont.	
37.2	10.85	1.429	$In_2(SO_4)_3 \cdot 6H_2O + In_2(SO_4)_3 \cdot H_2SO_4 \cdot 7H_2O$
41.0	9.02	1.422	$In_2(SO_4)_3 \cdot H_2SO_4 \cdot 7H_2O$
42.6	7.46	1.422	"
44.7	5.86	1.407	"
46.6	3.95	1.417	"
50.8	1.80	1.417	"
53.7	0.74	1.450	"
57.0	0.36	1.476	"
62.2	0.21	1.533	"
		Results at 60°	
2.9	54.80	1.772	$In_2(SO_4)_3 \cdot 6H_2O$
2.8	54.12	1.769	"
5.2	51.87	1.740	"
9.5	46.23	1.678	"
10.6	44.56	1.667	"
11.8	43.97	1.655	"
13.0	41.27	1.650	"
14.2	39.24	1.645	"
16.6	36.31	1.610	"
18.4	34.05	1.587	"
22.5	28.86	1.533	"
27.5	22.26	1.490	"
30.6	18.42	1.456	"
33.8	16.32	1.451	"
36.7	12.65	1.426	"
38.7	8.24	1.417	"
43.5	6.72	1.410	"
50.6	2.86	1.420	"
52.8	2.05	1.432	"
54.4	1.62	1.447	$In_2(SO_4)_3 \cdot H_2SO_4 \cdot 7H_2O$
60.6	0.61	1.513	"
68.0	0.37	1.598	"
84.4	0.13	1.780	"

SO

Ir IRIDIUM Ir

Noddack, Noddack, and Bohnstedt (1940) found that metallic iridium was concentrated in the iron phase in the system Fe + FeS at the eutectic temperature of the system.

K POTASSIUM K

The eutectic temperature of the system $K - NH_3$ is -157°. (Birch and MacDonald, 1947).

Cubicciotti (1949) studied the system $K - KI - NH_3$ at -31°. Two liquid layers are formed and K and KI are miscible in all proportions only when the mole fraction of NH_3 is greater than 0.95.

Rinck, 1932 studied the reactions $K + NaF \rightleftharpoons KF + Na$, $K + NaCl \rightleftharpoons KCl + Na$, $K + NaBr \rightleftharpoons KBr + Na$, and $K + NaI \rightleftharpoons KI + Na$ at 900° and $K + NaOH \rightleftharpoons KOH + Na$ at 800°.

BO

POTASSIUM TETRABORATE $K_2B_4O_7$

Melting points in the systems $K_2B_4O_7 + Na_2B_4O_7$, $K_2B_4O_7 + K_2F_2$, $K_2B_4O_7 + KCl$ and in the quaternary systems $K_2B_4O_7 + Na_2F_2$ and $K_2B_4O_7 + Na_2Cl_2$ were determined by Bergman and Nikonova, 1942.

The specific volume of each component in the system $K_2B_4O_7 + B_2O_3$ was determined by Leontjewa, 1937.

Br

POTASSIUM BROMIDE KBr

SOLUBILITY OF POTASSIUM BROMIDE IN WATER AND DEUTERIUM OXIDE

(Eddy and Menzies, 1940)

Small closed vessels containing about one gram of solvent were used, and the D_2O had a purity of 99.4%, determined from its freezing point. Including corrections for the volume of water in the vapor phase, the authors estimate the accuracy of each determination at 1%. The experimental results were plotted, and the authors read the following rounded values from the curve. The original data are given as moles of salt per 55.51 moles of solvent.

t°	Gms. KBr per 100 gms.		t°	Gms. KBr per 100 gms.	
	H_2O	D_2O		H_2O	D_2O
0	52.8	38.8	90	100.0	84.7
5	56.0	42.5	95	102.4	86.8
10	59.1	45.8	100	104.8	89.0
15	62.2	48.9	105	107.2	91.1
20	65.2	51.8	110	109.6	93.2
25	68.0	54.6	115	111.9	95.4
30	70.7	57.3	120	114.3	97.5
35	73.3	59.8	125	116.7	99.6
40	76.0	62.4	130	119.1	101.8
45	78.4	64.8	135	121.5	103.9
50	80.9	67.1	140	123.9	106.1
55	83.4	69.4	145	126.2	108.3
60	85.8	71.6	150	128.6	110.4
65	88.2	73.8	155	131.0	112.6
70	90.5	76.1	160	133.4	114.7
75	92.9	78.3	165	135.8	116.9
80	95.3	80.4	170	138.1	119.0
85	97.7	82.5			

EQUILIBRIUM IN THE SYSTEM POTASSIUM BROMIDE - POTASSIUM CHLORIDE - WATER AT 25°

(Platt and Burkhardt, 1944)

The data, indicating a continuous solid solution between the salts, agree with those of previous authors (Vol. I, p. 688).

Moles KBr per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Moles KBr per 100 moles of Solid Phase	Moles KBr per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Moles KBr per 100 moles of Solid Phase
0.0	11.40	0.0	66.2	8.95	67.8
23.4	10.47	6.8	74.5	9.08	80.0
43.3	9.70	18.3	82.4	9.31	88.5
49.6	9.26	28.4	91.8	9.46	95.7
60.0	9.12	53.8	100.0	9.63	100.0

SOLUBILITY OF POTASSIUM BROMIDE IN POTASSIUM CHLORIDE SOLUTIONS AND VICE VERSA

(Bergman and Vlassov, 1942)

Br

The eutectic point of the system KBr + KCl + H_2O occurs at -13.4°, 6.6% KCl, 25.6% KBr. KCl + KBr exhibit two forms of solid solutions, α and β, and the transition temperature ranges from 13.5° to 27° depending on the composition of the solid. The minimum temperature occurs in solutions containing 60% KBr. ($\alpha \rightleftharpoons \beta$ KCl at -27°, $\alpha \rightleftharpoons \beta$ KBr at +20°).

t°	Gms. KBr per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	t°	Gms. KBr per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.
-10	*0.0	19.0	10	0.0	23.4
	*8.8	12.4		8.1	19.1
	*19.0	5.0		17.1	14.4
	*26.6	0.0		25.2	9.6
-5	*0.0	12		30.4	5.2
	*9.6	4.3		36.6	0.0
	*16.0	0.0	15	0.0	24.2
-10	0.0	20.2		8.1	20.0
	8.4	15.8		16.9	15.4
	17.8	11.0		25.0	10.7
	26.5	4.9		30.0	6.5
	31.4	0.0		36.8	0.0
-5	0.0	20.8	20	0.0	25.0
	8.3	16.6		8.0	20.8
	17.6	11.7		16.8	16.2
	26.3	5.8		24.7	11.7
	31.7	1.3		29.6	7.8
	32.8	0.0		39.2	0.0
0	0.0	21.8	25	0.0	25.8
	8.3	17.6		7.9	21.7
	17.4	12.6		16.7	16.8
	26.0	7.1		24.5	12.4
	31.2	2.7		29.1	9.0
	34.0	0.0		40.6	0.0
5	0.0	25.6	30	0.0	26.6
	8.2	18.4		7.8	22.6
	16.2	13.6		16.5	17.4
	25.7	8.2		24.3	13.0
	30.7	4.2		28.8	10.0
	35.2	0.0		41.9	0.0

EQUILIBRIUM IN THE SYSTEM POTASSIUM BROMIDE - POTASSIUM CHLORIDE - WATER

(Schlesinger, Zorkin, and Novogenova, 1938)

The salts exhibit continuous solid solutions, and the results are also expressed in various molar bases.

Gms. KCl per 100 gms. Sat. Sol.	Gms. KBr per 100 gms. Sat. Sol.	Density $t°/4°$	Gms. KCl per 100 gms. Solid Phase
	Results at 0°		
21.925	0.539	1.155	99.590
21.850	0.640	1.154	99.508
20.360	3.360	1.169	96.838
18.048	8.184	1.196	90.111
12.480	19.519	1.264	68.075
11.048	22.310	1.280	43.469
8.109	26.247	1.296	22.219
4.573	30.504	1.312	7.522
	Results at 35°		
27.95	0.0	1.185	100.0
28.04	0.18	1.186	99.881
27.40	0.61	1.186	99.584
26.79	1.60	1.192	98.879
26.46	2.91	1.198	97.701
23.69	7.30	1.221	93.836
23.08	8.15	1.224	92.916
21.65	10.68	1.239	90.382
21.75	11.12	1.242	89.656
20.67	13.02	1.253	87.630
20.14	14.63	1.265	84.485
14.23	24.24	1.320	56.188
13.76	25.22	1.324	52.852
10.64	30.18	1.349	27.651
10.34	30.40	1.350	26.143
9.19	32.11	1.359	20.160
5.09	36.50	1.373	8.593
2.77	39.64	1.387	4.050
0.0	42.59	1.397	0.0

THE SYSTEM POTASSIUM BROMIDE - POTASSIUM CHLORIDE - WATER AT 25°

(Zbdanov, 1948)

Gms. KBr per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Gms. KBr per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.
0.0	26.27	26.58	11.83
2.85	24.75	26.90	11.32
5.66	23.33	27.13	11.08
8.51	21.96	27.42	11.03
14.48	18.22	27.91	10.52
17.12	17.20	28.20	10.72
19.31	15.74	28.38	10.22
21.85	14.91	28.76	9.89
23.42	13.31	28.93	9.85
24.27	12.77	29.09	9.65
25.38	12.19	40.62	0.0

The compositions of several saturated solutions in the system KBr + KCl + KI + H_2O at 25° are also given by Zhdanov, 1948.

EQUILIBRIUM IN THE SYSTEM POTASSIUM BROMIDE - AMMONIUM BROMIDE - WATER AT 25°

(Flatt and Burkhardt, 1944)

The results agree fairly well with those of Fock (Vol. I, p. 691), except that the solution simultaneously saturated with the two series of solid solutions was found to contain 75.7 mole % NH_4Br rather than 70.3% as previously reported.

Moles NH_4Br per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Moles NH_4Br per 100 moles Solid Phase	Moles NH_4Br per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Moles NH_4Br per 100 moles Solid Phase
0.0	9.63	0.0	73.4	6.25	49.5
27.8	8.56	8.7	74.6	6.20	50.4
48.1	7.63	18.2	*75.7	6.22	93.8
54.4	7.17	23.5	75.8	6.19	-
63.6	6.87	33.1	76.2	6.23	98.4
64.4	6.70	-	78.7	6.22	98.7
69.4	6.42	43.6	84.3	6.42	98.8
69.5	6.48	43.0	100.0	6.92	100.0

*In equilibrium with 2 solid solutions (isothermally invariant)

EQUILIBRIUM AT 25° FOR THE RECIPROCAL SALT PAIR $NH_4Cl + KBr \rightleftharpoons KCl + NH_4Br$

(Flatt and Burkhardt, 1944)

Saturated Solution			Solid Solution I		Solid Solution II	
Moles Br^- per 100 moles $Br^- + Cl^-$	Moles NH_4^+ per 100 moles $NH_4^+ + K^+$	Moles H_2O per mole of Dissolved Salts	Moles Br^- per 100 moles $Br^- + Cl^-$	Moles NH_4^+ per 100 moles $NH_4^+ + K^+$	Moles Br^- per 100 moles $Br^- + Cl^-$	Moles NH_4^+ per 100 moles $NH_4^+ + K^+$
0	74.2	6.67	0.0	26.6	0.0	98.6
10	74.3	6.58	4.2	30.7	1.5	98.2
20	75.0	6.06	10.6	36.4	4.6	97.6
30	76.3	5.75	20.0	43.8	9.0	97.2
40	78.6	5.52	33.0	52.6	16.6	97.2
50	81.0	5.41	48.3	60.2	36.0	98.0
60	81.0	5.40	64.4	62.1	72.0	98.0
70	79.4	5.52	76.5	59.2	84.8	97.2
80	77.7	5.71	86.0	56.0	91.2	97.2
90	75.9	5.94	94.2	52.9	95.6	97.6
100	75.7	6.20	100.0	50.4	100.0	98.4

EQUILIBRIUM IN THE SYSTEM POTASSIUM BROMIDE - SODIUM BROMIDE - WATER

(Vlassov and Bergman, 1943)

The system was studied from the eutectic (-32°) to 50°, and the transition temperatures for $\alpha KBr \rightleftharpoons \beta KBr$ were determined as a function of the amount of sodium bromide in solution.

Gms. NaBr per 100 gms. Sat. Sol.	Gms. KBr per 100 gms. Sat. Sol.	Solid Phase
Results at -20°		
32.8	0.0	Ice
31.0	1.8	"
28.2	6.5	"
22.4	13.3	KBr + Ice
26.9	10.7	KBr
35.5	6.1	"
38.0	4.4	"
38.0	3.5	KBr + $NaBr \cdot 2H_2O$
40.2	2.1	$NaBr \cdot 2H_2O$
41.7	0.0	"
Results at -10°		
21.6	0.0	Ice
12.4	3.0	"
8.3	16.0	"
0.0	26.6	"
0.0	31.4	KBr
7.4	25.6	"
16.1	18.6	"
26.4	12.2	"
35.0	7.6	"
39.6	4.6	"
39.8	4.5	KBr + $NaBr \cdot 2H_2O$
40.3	4.0	$NaBr \cdot 2H_2O$
41.5	2.2	"
43.2	0.0	"
Results at 0°		
44.3	0.0	$NaBr \cdot 2H_2O$
43.0	2.3	"
41.5	4.7	"
41.2	4.8	$NaBr \cdot 2H_2O$ + KBr
39.4	6.1	KBr
34.3	9.1	"
25.9	14.0	"
15.8	21.0	"
7.1	28.2	"
0.0	34.0	"
Results at 10°		
45.9	0.0	$NaBr \cdot 2H_2O$
44.4	2.4	"
43.0	5.0	"
42.6	5.4	$NaBr \cdot 2H_2O$ + KBr
42.3	5.7	KBr
38.6	7.9	"
33.8	10.6	"
25.4	15.6	"
15.3	23.2	"
6.8	30.7	"
0.0	36.7	"

Gms. NaBr per 100 gms. Sat. Sol.	Gms. KBr per 100 gms. Sat. Sol.	Solid Phase
Results at 20°		
47.6	0.0	$NaBr \cdot 2H_2O$
46.4	2.5	"
45.3	3.6	"
43.8	6.3	$NaBr \cdot 2H_2O$ + KBr
41.6	7.5	KBr
38.0	9.4	"
33.4	11.7	"
24.9	17.5	"
14.8	25.6	"
6.5	33.2	"
0.0	39.4	"
Results at 25°		
48.6	0.0	$NaBr \cdot 2H_2O$
47.1	2.6	"
45.6	5.2	"
44.4	6.7	$NaBr \cdot 2H_2O$ + KBr
41.2	8.2	KBr
37.7	10.1	"
33.2	12.4	"
24.6	18.4	"
14.6	26.8	"
6.4	34.4	"
0.0	10.6	"
Results at 30°		
49.4	0.0	$NaBr \cdot 2H_2O$
47.9	2.6	"
46.3	5.3	$NaBr \cdot 2H_2O$ + KBr
45.0	7.1	KBr
43.6	7.0	"
40.8	9.0	"
37.5	10.7	"
33.0	13.0	"
24.3	19.3	"
14.4	27.9	"
6.2	35.8	"
0.0	39.0	"
Results at 50°		
53.7	0.0	NaBr
49.38	6.78	"
48.15	8.18	"
37.64	13.48	KBr
36.94	14.42	"
34.28	17.42	"
33.10	18.60	"
32.76	17.20	"
14.57	31.18	"
13.39	32.42	"
0.0	44.5	"

Br

$\alpha \rightleftharpoons \beta$ KBr Transition Points

(22.0°)	0.0	40.0	·KBr + ·KBr
(19.0°)	6.7	23.3	"
(16.0°)	14.8	25.2	"
(12.0°)	25.5	16.5	"
(10.0°)	33.8	10.6	"
(9.0°)	39.8	7.6	"

Invariant Points

(-32.0°)	36.5	4.0	Ice + α-KBr + $NaBr \cdot 5H_2O$
(-20.0°)	38.0	3.6	·KBr + $NaBr \cdot 5H_2O$ + $NaBr \cdot 2H_2O$
(46°)	47	7.8	$NaBr \cdot 2H_2O$ + NaBr + β-KBr
(7.0°)	41.4	5.4	α-KBr + β-KBr + $NaBr \cdot 2H_2O$

Br EQUILIBRIUM IN THE SYSTEM POTASSIUM BROMIDE - POTASSIUM DICHROMATE - WATER

(Bogoyavlenskii, 1949)

The results are also given in mole %.

Gms. per 100 gms. Saturated Solution		Solid Phase	Gms. per 100 gms. Saturated Solution		Solid Phase
$K_2Cr_2O_7$	KBr		$K_2Cr_2O_7$	KBr	
Results at 0°			Results at 10°		
4.43	0.0	$K_2Cr_2O_7$	7.50	0.0	$K_2Cr_2O_7$
2.20	2.90	"	4.90	2.85	"
1.20	6.90	"	3.20	6.78	"
0.70	14.90	"	1.40	14.80	"
0.40	25.76	"	1.00	19.82	"
0.30	34.30	$K_2Cr_2O_7$ + KBr	0.50	37.90	$K_2Cr_2O_7$ + KBr
0.0	34.5	KBr	0.0	38.1	KBr
Results at 20°			Results at 30°		
11.10	0.0	$K_2Cr_2O_7$			
8.06	3.96	"			
4.53	9.92	"	15.40	0.0	$K_2Cr_2O_7$
2.55	16.96	"	10.32	6.04	"
1.93	22.1	"	4.94	16.53	"
1.19	30.81	"	2.56	26.47	"
0.88	34.75	"	1.56	34.33	"
0.65	39.15	$K_2Cr_2O_7$ + KBr	0.95	40.94	$K_2Cr_2O_7$ + KBr
0.0	39.40	KBr	0.0	41.45	KBr
Results at 40°					
20.60	0.0	$K_2Cr_2O_7$	4.21	23.50	$K_2Cr_2O_7$
14.58	6.84	"	1.65	42.42	$K_2Cr_2O_7$ + KBr
7.23	18.70	"	0.0	43.2	KBr

Data for the system KBr - Urea - Water are given by Bokhovkin and Bokovkina, 1949 from the eutectic to 26°. The eutectic solution contains 24.3% KBr, 24.6% Urea, and freezes at -20.8° in equilibrium with ice, α-KBr, and γ-urea. The data are presented as the freezing points of solutions of urea in water with small additions of KBr.

The system KCl + KBr + HBr + H_2O was studied by Petrov and Ilin, 1939 by adding conc. HBr to solutions of KBr + KCl, and by isothermal evaporations.

100 gms. of a saturated solution of potassium bromide in liquid sulfur dioxide contain 0.50 gms. KBr at 25°. (Shatenstein and Viktorov, 1937).

SOLUBILITY OF POTASSIUM BROMIDE IN ORGANIC SOLVENTS AT 25°
(Isbin and Kobe, 1945)

Solvent	Gms. KBr per 100 gms. Solvent
Ethylenediamine	0.78
Monoethanolamine	3.27
Ethylene Glycol	15.5

SOLUBILITY OF POTASSIUM BROMIDE IN GLYCOL Br
(Semenchenko and Shakparonov, 1948a)

Gms. KBr per 100 gms. Sat. Sol.	Temperature of Crystallization	Gms. KBr per 100 gms. Sat. Sol.	Temperature of Crystallization
12.0	-0.7°	13.5	+25.7°
12.5	+7.7°	14.0	+31.5°
13.0	+17.0°	15.0	+51.8°

0.05 gms. of KBr are dissolved in 100 gms. of a saturated solution in furfural at 25°. (Trimble, 1941).

Melting point data are given for the following systems:

KBr + $PbBr_2$ (Pokotilo and Pokotilo, 1940)
KBr + KVO_3 (Schmitz-Dumont and Schmitz, 1944)
KBr + KCl + K_2SO_4 (Glistenko, 1940)
K^+, Na^+, F^-, Br^-, I^- (Dombrovskaya, 1943)

The reactions below the melting points were studied by Link and Wood, 1940 for the following salt pairs:

KBr + RbF
KBr + CsF

POTASSIUM iodo di BROMIDE Br

Correction to Volume 8, p. 696 "Potassium Iodo DiBromide"

The data for CCl_4 should read:

At 25°, one liter of saturated solution of potassium iodo dibromide in carbon tetrachloride contains 0.0473 gm. atoms of Halogen produced by the dissociation of the compound into KBr and IBr. (Cremer and Duncan, 1931).

BrO POTASSIUM BROMATE $KBrO_3$

SOLUBILITY OF POTASSIUM BROMATE IN LITHIUM CHLORIDE SOLUTIONS IN ALCOHOL AT 15°

(Gross, Kuzmany, and Wald, 1937)

100% C_2H_5OH was used $d\ \frac{15}{4} = 0.79359$

Moles LiCl per liter	Moles $KBrO_3$ per liter x 10^4	Moles LiCl per liter	Moles $KBrO_3$ per liter x 10^4
0.0	0.8088	11.07	1.015
1.191	.8583	15.87	1.076
2.942	.8947	20.34	1.139
5.769	.9465	24.52	1.169

0.01 gms. of $KBrO_3$ are dissolved in 100 gms. of a saturated solution in furfural at 25°. (Trimble, 1941)

Less than 0.005 gms. $KBrO_3$ dissolve in 100 gms. of ethylene diamine at 25°. (Isbin and Kobe, 1945)

CH POTASSIUM ACETATE CH_3COOK

Correction to Volume I, p. 700, line 14

Should read: "The lowest f.pt., 233°, was found for a mixture containing 46 mol. percent CH_3COOK."

C POTASSIUM TETRACHLOROPHTHALATE $C_6Cl_4(COOK)_2$

SOLUBILITY IN WATER

(Lawlor, 1947)

t°	Gms. $C_6Cl_4(COOK)_2$ per 100 gms. Sat. Sol.	t°	Gms. $C_6Cl_4(COOK)_2$ per 100 gms. Sat. Sol.
5	28.3	23	29.3
14	28.9	59	34.5
20	29.1	75	37.5

CH POTASSIUM TARTARATE $K_2C_4H_4O_6$

EQUILIBRIUM IN THE SYSTEM POTASSIUM TARTARATE - POTASSIUM HYDROXIDE - WATER AT 17°

(Peyronel, 1949b)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$K_2C_4H_4O_6$	KOH		$K_2C_4H_4O_6$	KOH		$K_2C_4H_4O_6$	KOH	
58.25	0.0	A	21.70	32.50	A	6.00	48.30	B
53.30	2.26	A	21.40	34.33	A	5.96	48.25	B
51.92	2.73	A	22.09	35.02	A	5.44	48.81	B
43.60	9.33	A	21.25	35.34	A	4.15	50.12	B
41.20	10.11	A	25.00	36.17	A + B	4.18	50.85	B
29.90	19.52	A	20.80	36.75	B	4.47	51.45	B + C
29.74	20.25	A	19.45	37.57	B	7.84	50.43	C
22.05	25.52	A	18.65	38.55	B	9.76	48.70	C
20.20	28.36	A	14.90	40.30	B	10.75	47.80	C
22.32	29.00	A	14.30	41.50	B	13.25	46.28	C
22.68	29.22	A	11.56	42.90	B	16.00	44.50	C
22.42	30.72	A	8.85	45.71	B	2.93	52.35	C
20.75	32.38	A	6.15	47.55	B	0.0	52.00	C
21.67	32.18	A						

A = $K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$ B = $K_2C_4H_4O_6 \cdot KOH \cdot 1\frac{1}{2}H_2O$ C = $KOH \cdot 2H_2O$

EQUILIBRIUM IN THE SYSTEM POTASSIUM TARTARATE - POTASSIUM CARBONATE - WATER AT 17°

(Peyronel, 1949b)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$K_2C_4H_4O_6$	K_2CO_3		$H_2C_4H_4O_6$	K_2CO_3	
58.25	0.0	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$	11.63	38.93	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$
49.80	4.08	"	6.37	46.20	"
43.55	8.76	"	4.73	48.75	"
31.35	19.06	"	4.17	49.70	"
31.00	18.80	"	5.66	49.60	"
28.75	21.67	"	5.00	49.75	"
19.18	31.50	"			$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O + K_2CO_3 \cdot 2H_2O$
15.32	35.25	"	0.0	52.64	$K_2CO_3 \cdot 2H_2O$

POTASSIUM Hydrogen TARTARATE $KHC_4H_4O_6$ C_4H

SOLUBILITY IN UREA AND DIOXANE SOLUTIONS

(Pederson, 1941)

Temp. = 17.85°		Temp. = 18.00°	
Moles Urea per 1000 ml. of Solvent	Moles $KHC_4H_4O_6$ per 1000 ml. Sat. Sol.	Moles Dioxane per 1000 ml. Solvent	Moles $KHC_4H_4O_6$ per 1000 ml. Sat. Sol.
0.0	0.02600	0.0	0.02617
.250	.02646	.250	.02417
.500	.02688	.500	.02227
.750	.02734	.750	.02052
1.000	.02772	1.000	.01883

The solubility of potassium bitartarate in alcohol solutions from 5° to 25° has been determined by Ivanov, 1947. The effect of added organic acids was also studied.

POTASSIUM 3-chloro-3-nitro-p-Xylene SULFONATE $[C_6H(CH_3)_2NO_2(Cl)SO_3]K$ CH

At 30°, 100 gms. of water dissolve 9.21 gms. (30.4 millimoles) of the salt. (Dermer and Dermer, 1939).

POTASSIUM METHYL PICRATE $[C_6H(NO_2)_3CH_3C]K$ CH

At 30°, 100 gms. of water dissolve 3.78 gms. (13.4 millimoles) of the salt. (Dermer and Dermer, 1939).

POTASSIUM CHLOROPICRATE $[C_6H(NO_2)_3ClO]K$ CH

At 30°, 100 gms. of water dissolve 1.82 gms. (6.03 millimoles) of the salt. (Dermer and Dermer, 1939).

CH **POTASSIUM STYPHNATE** $[C_6H(NO_2)_3(OH)O]K$ (?)

At 30°, 100 gms. of water dissolve 1.54 gms. (5.42 millimoles) of the salt. (Dermer and Dermer, 1939).

CH **POTASSIUM FLAVIANATE (dibasic)** $[C_{10}H_4(NO_2)_2(SO_3)O]K_2 \cdot H_2O$

At 30°, 100 gms. of water dissolve 1.03 gms. (2.5 millimoles) of the salt. (Dermer and Dermer, 1939).

CH **POTASSIUM PICRATE** $C_6H_2(NO_2)_3OK$

At 30°, 100 gms. of water dissolve 0.755 gms. (2.84 millimoles) of the salt. (Dermer and Dermer, 1939).

CH **POTASSIUM NITRANILATE** $[C_6H_5N_2OO]K$

At 30°, 100 gms. of water dissolve 0.567 gms. (1.85 millimoles) of the salt. (Dermer and Dermer, 1939).

CH **POTASSIUM PICROLONATE** $[C_3H\ N_2(CH_3)(NO_2)(C_6H_4NO_2)O]K$

At 30°, 100 gms. of water dissolve 0.338 gms. (1.12 millimoles) of the salt. (Dermer and Dermer, 1939).

POTASSIUM DIPICRYLAMINATE $K[(NO_2)_3C_6H_2NHC_6H_2(NO_2)_3]$

SOLUBILITY IN WATER

t°	Moles per liter	t°	Moles per liter
0	1.53×10^{-4} (1)	30	3.04×10^{-3} (4)*
15	2.0×10^{-3} (2)	35	3.1×10^{-3} (2)
20	1.22×10^{-3} (3)	45	3.7×10^{-3} (2)
25	1.85×10^{-3} (1)		
	2.5×10^{-3} (2)		

*Moles per 1000 gms. H_2O

(1) Kolthoff and Bendix, 1939 (2) Kielland, 1938
(3) Treadwell and Hepenstrick, 1949 (4) Dermer and Dermer, 1939

POTASSIUM 2, 4 - DINITROPHENATE $(C_6H_3(NO_2)_2O)K$ See note p. 66

At 4° between 1% and 2% dissolve in water.
At 15° between 2% and 4% dissolve in water.
- Fastac and Lecrivain, 1948.

POTASSIUM 2, 4 - DINITROCRESYLATE $(C_6H_2(CH_3)(NO_2)_2O)K$ See note p. 66

At 15° between 2% and 4% dissolve in water.
- Fastac and Lecrivain, 1948.

POTASSIUM LACTATE $CH_3CHOHCOOK$ CH

FREEZING POINTS OF POTASSIUM LACTATE SOLUTIONS
(Dietz, Degering, and Schopmeyer, 1941)

Gms. Potassium Lactate per 100 gms. Sat. Sol.	t°	Gms. Potassium Lactate per 100 gms. Sat. Sol.	t°
5	-1.6	30	-16.1
10	-3.7	40	-28.1
20	-8.6	50	-51.0

The density, refractive index, viscosity, boiling points and surface tension of various potassium lactate solutions are also reported.

POTASSIUM ANTHRACENE SULFONATES $C_{14}H_8S_2O_6K_2$ $C_{14}H_9SO_3K$ CH

SOLUBILITY IN WATER
(Federov and Lodygin, 1942)

	Gms. Salt per 100 gms. Saturated Solution	
	20°	100°
α-$C_{14}H_9SO_3K$	0.412	5.367
β-$C_{14}H_9SO_3K \cdot 2H_2O$	0.156	0.601
1, 5 - $C_{14}H_8S_2O_6K_2 \cdot 2H_2O$	4.598	14.240
1, 8 - $C_{14}H_8S_2O_6K_2 \cdot H_2O$	2.320	11.670
2, 6 - $C_{14}H_8S_2O_6K_2$	1.638	19.410
2, 7 - $C_{14}H_8S_2O_6K_2$	1.005	10.890

POTASSIUM DILITURATE (18.52%K) $C_4H_2N_3O_5K$ CH

t°	Solubility	Author
18	0.0022 moles per 1000 gms. Sat. Sol.	(Fredholm, 1936)
30	0.086 gms. (0.40 millimoles) salt per 100 gms. H_2O.	(Dermer and Dermer, 1939)

POTASSIUM LAURATE $[CH_3(CH_2)_{10}COO]K$ CH

The solubility of potassium laurate in solutions containing up to 35% potassium silicate (SiO_2/K_2O by wt. = 2.04) from 0° to 175° is given by Merrill, 1948. The temperatures at which birefringent phases appeared were used to outline the concentration limits of the isotropic solutions.

POTASSIUM OLEATE $[C_8H_{17}CH = CH(CH_2)_7COO]Na$ CH

The freezing point depressions of potassium oleate solutions containing excess KOH or iso-octane were measured by Johnston and McBain, 1942 over the range 0 - 0.16 molar.

CH **POTASSIUM METHYL ORANGE** $(CH_3)_2NC_6H_4N_2C_6H_4SO_3K$

The phase diagram for the system potassium methyl orange - water in which liquid crystals are formed is given by Branner, 1939.

CNS **POTASSIUM THIOCYANATE** KCNS

THE SYSTEMS POTASSIUM THIOCYANATE - IODINE - BENZENE AND POTASSIUM THIOCYANATE - IODINE - TOLUENE AT 6°
(Foote and Fleischer, 1940)

Gms. I_2 per 100 gms. Sat. Sol.	Solid Phase	Gms. I_2 per 100 gms. Sat. Sol.	Solid Phase
With Benzene		With Toluene (no compound formed)	
7.34	KCNS		
8.15	KCNS + $KCNS \cdot 6I \cdot 4C_6H_6$	10.21	KCNS + I_2
7.93	"	10.29	"
8.11	"	10.18	"
7.91	"		
8.30	$KCNS \cdot 6I \cdot 4C_6H_6$		
8.45	"		
8.59	"		
8.70	$KCNS \cdot 6I \cdot 4C_6H_6 + I_2$		
8.69	"		

83.0 gms. KCNS dissolve in 100 gms. of ethylenediamine at 25°. (Isbin and Kobe, 1945)

Melting points in the system KCNS + KNO_2 (Falkina, 1945) show a 1:1 incongruently melting compound. The mixtures explode at about 400°.

CN **POTASSIUM ARGENTOCYANIDE** $KAg(CN)_2$

SOLUBILITY IN DEUTERIUM OXIDE SOLUTIONS AT 5°
(Noonan, 1948)

Mole % D_2O	Moles $KAg(CN)_2$ per 100 moles $H_2O + D_2O$
0	1.290
90.86	1.015
100.0	0.974

POTASSIUM Calcium FERROCYANIDE $K_2Ca[Fe(CN_6)]$

The effect of added salts on the solubility of $K_2Ca[Fe(CN)_6]$ in water was studied by Tananaev and Tikhomirova, 1945.

POTASSIUM CARBONATE K_2CO_3

SOLUBILITY OF POTASSIUM CARBONATE IN AMMONIA SOLUTIONS

(Guyer, Bieler, and Orelli, 1940)

The data below were read from curves given by the authors and are in grams of K_2CO_3 per 100 grams of solvent.

% NH_3 in Solvent	-30°	-10°	0°	19°
3	-	34	52	50.5
5	-	28	51	49
10	-	-	45	-
20	3	-	-	8
30	2	3	4	5
40	1	2	-	-
60	1	-	3	4
80	1	2	3	3

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE - HYDRAZINE - WATER AT 50°

(Penneman and Audrieth, 1949)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
N_2H_4	K_2CO_3		N_2H_4	K_2CO_3	
97.0	0.6	$K_2CO_3 \cdot 3/2H_2O$	28.7	25.0	$K_2CO_3 \cdot 3/2H_2O$
69.8	2.7	"	16.2	38.5	"
53.4	6.0	"	7.6	47.9	"
40.5	14.3	"			

EQUILIBRIUM IN THE SYSTEMS POTASSIUM CARBONATE - LITHIUM CARBONATE - WATER AT 25°

(Urazov and Lifatova, 1944)

The data are also given in mole % and moles per 100 gms. of H_2O.

Gms. Li_2CO_3 per 100 gms. Sat. Sol.	Gms. K_2CO_3 per 100 gms. Sat. Sol.	Solid Phase	Gms. Li_2CO_3 per 100 gms. Sat. Sol.	Gms. K_2CO_3 per 100 gms. Sat. Sol.	Solid Phase
0.0	52.97	$K_2CO_2 \cdot 2H_2O$	0.810	39.57	Li_2CO_3
0.276		"	0.913	34.06	"
0.378	52.93	"	0.879	29.69	"
0.403	51.73	"	1.068	19.62	"
0.476	52.85	"	1.123	10.96	"
0.553	52.71	$Li_2CO_3 + K_2CO \cdot 2H_2O$	1.239	0.0	"

COMPOSITIONS OF SOLUTIONS SATURATED WITH POTASSIUM CARBONATE AND POTASSIUM CHLORIDE

(Berg and Nikolajev, 1937)

t°	Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. H_2O		Solid Phase
	K_2CO_3	KCl	K_2CO_3	KCl	
20	51.9	0.8	109.7	1.7	K_2CO_3 + KCl
30	52.22	1.03	111.7	2.2	"
50	53.63	1.40	119.8	3.1	"
70	56.06	2.00	133.7	4.8	"
84	57.16	2.21	140.8	5.45	"
100	59.44	2.48	155.0	6.5	"
124.5	65.33	2.68	180.7	7.7	"
133.5	Constant boiling solution.				

CO EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE - SODIUM CARBONATE - WATER

(Makarow and Shulgina, 1940)

The results are also given in mole % and in moles per 1000 moles of water.

Gms. K_2CO_3 per 100 Gms. Sat. Sol.	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Solid Phase
	Results at 100°	
0.0	30.00	$Na_2CO_3 \cdot H_2O$
20.33	20.40	"
36.40	12.60	"
45.80	8.51	$Na_2CO_3 \cdot H_2O + K_2CO_3 \cdot Na_2CO_3$
52.20	5.01	$K_2CO_3 \cdot Na_2CO_3$
58.62	2.03	$K_2CO_3 \cdot 3/2H_2O + K_2CO_3 \cdot Na_2CO_3$
	Results at 120°	
0.0	30.00	Na_2CO_3
36.90	10.00	"
43.00	6.50	"
48.50	5.27	$Na_2CO_3 + K_2CO_3 \cdot Na_2CO_3$
54.20	3.80	$K_2CO_3 \cdot Na_2CO_3$
59.93	2.76	"
61.63	2.40	$K_2CO_3 \cdot 3/2H_2O + K_2CO_3 \cdot Na_2CO_3$
	Results at 140°	
0.0	29.00	Na_2CO_3
22.84	17.70	"
38.86	10.79	"
61.80	2.69	$Na_2CO_3 + K_2CO_3 \cdot Na_2CO_3$
62.07	3.60	"
62.43	2.42	"
64.02	2.68	$K_2CO_3 \cdot 3/2H_2O + K_2CO_3 \cdot Na_2CO_3$
67.98	1.39	$K_2CO_3 \cdot 3/2H_2O$

Results at 145°

Gms. K_2CO_3 per 100 gms. Sat. Sol.	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Solid Phase
0.0	28.00	Na_2CO_3
28.20	15.80	"
46.20	8.80	"
55.00	5.70	"
59.80	4.50	"
64.30	3.20	$K_2CO_3 \cdot 3/2H_2O + Na_2CO_3$
64.60	3.00	$K_2CO_3 \cdot 3/2H_2O$
67.10	2.20	"
68.70	1.20	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM CARBONATE - SODIUM CARBONATE - WATER CO

(Ervin, Giorgi, and McCarthy, 1944)

The data do not agree with those of Makarow and Shulgina, who found that above 100° the field of stability of the 1:1 double salt decreased and finally disappeared at 145°. The present authors allowed much more time for the attainment of equilibrium, and made independent determinations in two different types of equipment. They found that the compound $K_2CO_3 \cdot Na_2CO_3$ is stable at 150° and point out that this is in accord with theoretical considerations.

Results at 100°

Gms. K_2CO_3 per 100 gms. Sat. Sol.	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Solid Phase
60.9	0.0	$K_2CO_3 \cdot 3/2H_2O$
58.9	1.3	"
59.2	1.5	$K_2CO_3 \cdot 3/2H_2O + K_2CO_3 \cdot Na_2CO_3$
57.0	2.2	$K_2CO_3 \cdot Na_2CO_3$
57.0	2.7	"
52.0	4.7	"
51.9	3.8	"
51.8	4.4	"
49.9	6.0	"
49.8	5.3	"
47.2	6.6	"
45.4	7.5	"
44.6	8.4	"
44.0	8.6	$K_2CO_3 \cdot Na_2CO_3 + Na_2CO_3 \cdot H_2O$
42.2	9.1	$Na_2CO_3 \cdot H_2O$
41.4	9.3	"
40.5	10.1	"
37.7	10.3	"
35.1	12.4	"
29.7	14.8	"
29.4	15.3	"
28.6	16.1	"
27.0	15.2	"
20.8	19.7	"
17.0	20.0	"
16.2	21.8	"
12.2	24.1	"
0.0	30.9	"

Gms. K_2CO_3 per 100 gms. Sat. Sol.	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Solid Phase
71.0	0.0	$K_2CO_3 \cdot 3/2H_2O$
68.2	1.0	"
67.5	1.8	$K_2CO_3 \cdot 3/2H_2O + K_2CO_3 \cdot Na_2CO_3$
64.4	1.6	$K_2CO_3 \cdot Na_2CO_3$
63.3	2.0	"
58.7	2.7	"
55.0	4.2	"
52.7	5.7	"
50.2	6.6	"
47.5	8.4	"
46.4	8.6	$K_2CO_3 \cdot Na_2CO_3 + Na_2CO_3$
44.3	9.2	Na_2CO_3
29.6	14.8	"
16.1	20.1	"
0.0	27.7	"

CO

EQUILIBRIUM IN THE SYSTEMS POTASSIUM CARBONATE - ETHYLENE GLYCOL - WATER AND POTASSIUM CARBONATE - DIOXANE - WATER

(Kobe and Strong, 1940)

There is only one liquid layer in the system K_2CO_3 - Ethylene Glycol - Water, but two liquid layers are found in K_2CO_3 - Dioxane - Water. Results are in gms. per 100 gms. of saturated solution.

Results at 0°		Results at 25°			
Dioxane	K_2CO_3	Dioxane	K_2CO_3	Glycol	K_2CO_3
0.0	51.7	0.0	52.8	0.0	52.8
0.56	40.64	0.9	39.0	5.5	50.0
1.06	37.6	1.7	33.7	11.8	46.2
2.1	32.0	3.7	27.5	18.4	43.0
5.0	25.7	6.2	22.9	26.1	38.7
8.8	21.0	10.9	17.6	33.9	35.7
11.0	18.9	13.9	15.5	42.5	32.1
16.5	14.5	22.5	10.8	51.5	28.8
20.2	12.3	31.0	6.8	60.4	26.2
23.3	10.6	41.12	3.22	68.2	24.8
25.0	9.8	48.38	1.66	74.4	25.6
27.9	8.3	58.44	0.31		
35.8	4.8	67.59	0.21		
100.0	0.0	100.0	0.0		

— Results at 40° —					
Dioxane	K_2CO_3	Dioxane	K_2CO_3	Glycol	K_2CO_3
0.0	53.9	22.6	10.6	0.0	53.9
1.0	39.7	26.4	8.7	5.4	50.9
2.5	30.0	32.67	5.96	17.8	44.7
4.1	25.3	44.12	2.54	33.6	36.3
5.7	22.6	58.44	0.31	41.7	33.5
9.1	19.0	67.59	0.21	51.5	28.8
14.2	15.1	100.0	0.0	67.7	25.4
				73.5	26.5

Data for the system K_2CO_3-$KMnO_4$-H_2O at 25° are given by Filippeo and Voskresenskaya, 1940.

The melting of mixtures of K_2CO_3 and Na_2CO_3 have been determined by Makarow and Shulgina (1940a). At the melting points, a continuous series of solid solutions are formed. From 200° - 500° a 1:1 compound is found which forms solid solutions with each salt. There are several phase transitions, and the system was also studied by optical means.

Melting point diagrams for the reciprocal salt pairs $Na_2F_2 + K_2CO_3 \rightleftharpoons K_2F_2 + Na_2CO_3$ and $Na_2Cl_2 + K_2CO_3 \rightleftharpoons K_2Cl_2 + Na_2CO_3$ are given by Volkov and Bergman, 1942.

CO

POTASSIUM BICARBONATE $KHCO_3$

The diagram for the system K^+, Na^+, NH_4^+, Cl^-, HCO_3^- - H_2O at 20° is given by Schutze, Piechowicz, and Pustelnik, 1943. Their data for the invariant solutions are:

Moles per 1000 moles H_2O					Solid Phases
K	NH_4	Na	Cl	HCO_3	
53.5	34.3	-	-	87.8	$KHCO_3 + NH_4HCO_3$
51.9	34.4	11.1	-	97.4	$KHCO_3 + NH_4HCO_3 + NaHCO_3$
84.4	48.1	-	88.3	44.2	$KCl + KHCO_3 + NH_4HCO_3$
47.3	117.2	-	143.5	21.0	$KCl + NH_4Cl + NH_4HCO_3$
72.4	-	27.1	69.1	30.4	$KCl + KHCO_3 + NaHCO_3$
36.0	-	93.0	126.6	2.4	$KCl + NaCl + NaHCO_3$
27.0	70.3	74.8	167.1	5.0	$KCl + NH_4Cl + NaCl + NaHCO_3$
45.8	106.9	19.6	148.6	23.7	$KCl + NH_4Cl + NH_4HCO_3 + NaHCO_3$
76.5	50.7	12.8	92.9	47.1	$KCl + KHCO_3 + NH_4HCO_3 + NaHCO_3$

POTASSIUM OXALATE $K_2C_2O_4$

CO

SOLUBILITY OF POTASSIUM OXALATE IN WATER ABOVE 100°
(Benrath, 1942)

t°	Gms. $K_2C_2O_4$ per 100 gms. Sat. Sol.	t°	Gms. $K_2C_2O_4$ per 100 gms. Sat. Sol.
130	50	239	68
150	55	290	75
177	60	330	80
219	65		

EQUILIBRIUM IN THE SYSTEM POTASSIUM OXALATE - STANNIC OXALATE - WATER AT 25°

(Willard and Toribara, 1942)

Gms. $K_2C_2O_4$ per 100 gms. Sat. Sol.	Gms. $Sn(C_2O_4)_2$ per 100 gms. Sat. Sol.	Solid Phase
1.90	5.54	$3K_2C_2O_4 \cdot 2Sn(C_2O_4)_2 \cdot 4H_2O$ + ?
1.80	2.14	$3K_2C_2O_4 \cdot 2Sn(C_2O_4)_2 \cdot 4H_2O$
4.11	0.79	"
7.44	0.72	"
13.64	1.41	"
22.37	0.79	"
27.25	2.81	$3K_2C_2O_4 \cdot 2Sn(C_2O_4)_2 \cdot 4H_2O + K_2C_2O_4$?
27.80	1.25	$K_2C_2O_4 \cdot H_2O$
27.21	0.54	"
27.12	0.0	"

CO Mono POTASSIUM OXALATE KHC_2O_4

SOLUBILITY ABOVE 100°

(Benrath, 1942)

Temperature°	116	131	143	150
Gms. KHC_2O_4 per 100 gms. Sat. Sol.	40	45	50	53.2

CbO POTASSIUM COLUMBATES

SOLUBILITY IN WATER AT 25°

(P. Windmaisser, 1942)

Salt	Gms. Anhydrous Salt per 100 gms. Sat. Sol.
$4K_2O \cdot 3Cb_2O_5 \cdot 16H_2O$	56
*$7K_2O \cdot 6Cb_2O_5$ (?H_2O)	55.08
$KCbO_2 \cdot 2H_2O$	59.53

*The equilibrium diagram of the system $4K_2O \cdot 3Cb_2O_5 \cdot 16H_2O + K_2CO_3 + H_2O$ at 25° is also given. The 4:3 salt is converted to the 7:6 in solutions containing over 1% K_2CO_3. The previous 8:7 salt was shown actually to be 7:6.

POTASSIUM CHLORIDE KCl

Cl

SOLUBILITY OF POTASSIUM CHLORIDE IN AMMONIA SOLUTIONS

(Alexandrov, 1941)

Gms. NH_3 per 100 gms. H_2O in Sat. Sol.	Gms. KCl per 100 gms. H_2O in Sat. Sol.							
	-20°	-10°	0°	10°	20°	30°	40°	50°
0	-	25.0	28.5	31.5	34.5	37.3	40.1	42.9
10	-	18.3	22.1	23.8	26.6	29.3	32.0	34.8
20	11.5	14.0	16.5	19.0	21.4	23.8	26.3	28.8
25	10.2	12.5	15.0	17.3	19.7	22.0	24.2	26.7
30	9.1	11.3	13.7	15.9	18.1	20.3	22.5	24.8
40	7.4	9.7	11.7	13.9	16.2	18.2	20.4	22.8

SOLUBILITY OF POTASSIUM CHLORIDE IN AMMONIA SOLUTIONS

(E. Schmidt, Quoted by Achoumov, 1939)

Gms. NH_3 per 100 gms. Solvent	Gms. per 100 gms. Saturated Solution		Gms. NH_3 per 100 gms. Solvent	Gms. per 100 gms. Saturated Solution	
	NH_3	KCl		NH_3	KCl
	Results at -15°			Results at 25°	
0	0.0	19.0	0	0.0	26.5
60	58.16	3.07	60	57.38	4.37
70	68.80	1.72	70	68.31	2.42
80	79.37	0.79	80	79.76	1.30
90	89.70	0.33	90	89.50	0.56
100	99.868	0.132	100	99.96	0.04

SOLUBILITY OF POTASSIUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 0°

(Seidel and Fischer, 1941)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
HCl	KCl	HCl	KCl	HCl	KCl
0	21.9	32.1	0.98	39.2	1.28
22.5	2.14	33.6	1.00	43.4	1.81
26.9	1.31	34.7	1.03	44.7	2.11
29.6	1.08	38.0	1.19		

Nikolaeff and Kogan, 1938 determined the solubilities of KNO_3, KCl, and HNO_3 in solutions containing 5%, 7%, 10%, and 15% HCl in water from -50° to + 60°. The results are expressed in % N_2O_5, % K_2O, and % HCl in the saturated solutions.

COMPOSITION OF AMMONIA SOLUTIONS SATURATED WITH POTASSIUM CHLORIDE AND POTASSIUM NITRATE

(Alexandrov, 1946)

Gms. per 100 gms. H_2O			Density	Solid Phase
NH_3	KCl	KNO_3		
		Results at -10°		
10.0	17.9	3.3	1.074	KCl + KNO_3
25.0	12.0	1.8	0.995	"
39.3	9.2	1.7	0.946	"
		Results at 0°		
10.0	20.8	5.7	1.096	KCl + KNO_3
24.9	14.8	3.5	1.013	"
39.4	11.3	3.4	0.960	"
		Results at 20°		
10.0	26.4	12.9	1.143	KCl + KNO_3
25.0	19.2	9.4	1.042	"
41.4	14.7	9.2	0.979	"
		Results at 40°		
10.0	31.0	28.9	1.190	KCl + KNO_3
24.3	23.1	22.4	1.078	"
35.3	29.8	19.0	-	"
37.0	19.2	19.0	-	"

Cl

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - POTASSIUM NITRATE - WATER ABOVE 100°

(Benrath and Braun, 1940)

Gms. KCl per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 gms. Sat. Sol.	Moles KCl per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Solid Phase
		Results at 150°		
-	-	100	5.95	KCl
37.6	5.6	90.2	5.64	"
29.8	21.8	65.0	4.37	"
23.2	37.2	45.9	3.24	"
18.70	47.4	34.4	2.59	"
14.15	58.9	24.6	1.94	"
9.50	71.3	15.3	1.28	"
8.35	75.3	13.3	1.06	"
-	-	12.0	0.90	KCl + KNO_3
3.69	79.5	5.98	1.12	KNO_3
1.18	81.9	1.94	1.14	"
-	-	0.0	1.22	"

Gms. KCl per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 gms. Sat. Sol.	Moles KCl per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Solid Phase
		Results at 200°		
40.9	7.04	88.7	4.67	KCl
38.0	12.60	80.3	4.32	"
36.2	16.85	74.5	4.00	"
33.5	22.5	67.0	3.64	"
28.0	33.1	53.4	3.11	"
25.8	36.1	49.3	3.00	"
21.4	48.3	37.5	2.20	"
11.95	70.9	18.55	1.15	"
8.02	81.6	11.76	0.68	"
7.72	82.0	11.40	0.63	"
-	-	9.0	0.50	KCl + KNO_3
3.19	87.0	4.76	0.61	KNO_3
-	-	0.0	0.65	"
		Results at 250°		
-	-	100	4.35	KCl
44.9	5.9	91.2	4.14	"
41.6	13.9	80.2	3.55	"
39.6	18.3	74.6	3.28	"
30.0	37.4	52.2	2.35	"
18.3	62.0	28.6	1.20	"
12.34	75.7	18.25	0.72	"
9.56	82.4	13.60	0.47	"
-	-	6.5	0.25	KCl + KNO_3
0.59	93.7	0.85	0.34	KNO_3
-	-	0.0	0.38	"

Cl

EQUILIBRIUM IN THE SYSTEMS POTASSIUM CHLORIDE - POTASSIUM NITRATE - WATER POTASSIUM CHLORIDE - POTASSIUM CHLORATE - WATER AND POTASSIUM CHLORIDE - POTASSIUM PERCHLORATE - WATER ABOVE 100°

(Benrath and Braun, 1940)

Gms. KCl per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 gms. Sat. Sol.	Solid Phase
	Results at 150°	
37.6	5.6	KCl
29.8	21.8	"
23.2	37.2	"
18.70	47.4	"
14.15	58.9	"
9.50	71.3	"
8.35	75.3	"
3.69	79.5	KNO_3
1.18	81.9	"

Gms. KCl per 100 gms. Sat. Sol.	Gms. $KClO_3$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 150°	
34.7	10.40	KCl
34.4	10.88	"
31.7	17.80	"
28.5	23.7	"
26.0	29.5	"
18.22	37.9	$KClO_3$
16.90	38.9	"
4.97	50.6	"

Gms. KCl per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 gms. Sat. Sol.	Solid Phase
	Results at 200°	
40.9	7.04	KCl
38.0	12.60	"
36.2	16.85	"
33.5	22.5	"
28.0	33.1	"
25.8	36.1	"
21.4	48.3	"
11.95	70.9	"
8.02	81.6	"
7.72	82.0	"
3.19	87.0	KNO_3
	Results at 250°	
44.9	5.9	KCl
41.6	13.9	"
39.6	18.3	"
30.0	37.4	"
18.3	62.0	"
12.34	75.7	"
9.56	82.4	"
0.59	93.7	KNO_3

Gms. KCl per 100 gms. Sat. Sol.	Gms. $KClO_3$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 175°	
35.5	13.14	KCl
32.3	19.95	"
26.6	32.0	"
20.5	44.9	KCl + $KClO_3$
20.4	46.0	"
20.0	46.3	"
9.28	55.9	$KClO_3$
	Results at 200°	
38.5	12.3	KCl
35.6	16.8	"
25.2	36.8	"
21.6	45.9	"
14.55	58.0	"
5.76	66.6	KCl + $KClO_3$
3.29	69.4	$KClO_3$

Cl

Gms. KCl per 100 gms. Sat. Sol.	Gms. $KClO_4$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 150°	
39.6	3.46	KCl
39.1	5.17	"
35.0	11.2	KCl + $KClO_4$
35.3	11.6	"
33.0	12.3	$KClO_4$
25.3	17.08	"
23.1	17.7	"
16.0	23.7	"
11.62	26.5	"
	Results at 175°	
38.6	5.96	KCl
39.1	7.20	"
33.3	18.0	"
33.0	19.0	KCl + $KClO_4$
10.3	37.0	$KClO_4$
	Results at 200°	
41.3	5.7	KCl
38.8	12.2	"
36.2	16.45	"
33.9	21.5	"
32.2	23.3	"

Gms. KCl per 100 gms. Sat. Sol.	Gms. $KClO_4$ per 100 gms. Sat. sol.	Solid Phase
	Results at 200° (Con.)	
23.9	31.6	$KClO_4$
22.0	33.6	"
11.6	42.8	"
11.1	44.3	"
	Results at 225°	
38.7	15.4	KCl
29.8	31.8	"
28.4	34.7	"
26.6	38.0	KCl + $KClO_4$
26.4	39.2	"
26.0	39.0	"
15.08	47.5	$KClO_4$
11.34	51.9	"
	Results at 250°	
42.6	11.6	KCl
41.8	14.6	"
35.3	26.5	"
32.5	29.2	"
24.1	45.6	"
24.0	46.3	KCl + $KClO_4$
14.52	55.8	$KClO_4$

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - POTASSIUM PERCHLORATE - WATER

(Benrath, 1943)

t°	Gms. KCl per 100 gms. Sat. Sol.	Gms. $KClO_4$ per 100 gms. Sat. Sol.	Solid Phase
75	32.2	1.52	KCl + $\alpha KClO_4$
100	43.1	3.36	"
150	34.1	7.80	"
200	35.8	16.7	"
250	38.5	26.8	"

EQUILIBRIUM IN THE SYSTEM $NaClO_3 + KCl \rightleftharpoons KClO_3 + NaCl$ IN WATER

(Muntner and Brown, 1943)

Cl

t°	Saturated Solution Wt. % Cl	ClO_3	Na	K	H_2O	Density	Solid Phase
0	16.54	0.91	8.63	3.99	69.93	1.235	$KClO_3$ + NaCl + KCl
0	9.42	19.64	11.39	0.34	59.11	1.349	$KClO_3$ + NaCl + $NaClO_3$
*20	16.95	1.41	7.98	5.82	67.84	-	$KClO_3$ + NaCl + KCl
*20	8.50	22.80	11.20	1.00	56.50	-	$KClO_3$ + NaCl + $NaClO_3$
40	17.17	2.84	7.60	7.34	65.05	1.257	$KClO_3$ + NaCl + KCl
40	5.60	33.41	12.02	1.39	47.58	1.450	$KClO_3$ + NaCl + $NaClO_3$

The stable salt pair is NaCl + $KClO_3$ at each temperature.

*Data of DiCapua and Scaletti, 1927.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - POTASSIUM IODIDE - WATER

(Zhdanov and Kovolenko, 1948)

The results are also expressed in mole % and moles per 1000 gms. of water, and the compositions of the invariant solutions agree fairly well with those of Etard (Vol. I, p. 752).

Gms. KI per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase	Gms. KI per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase
		Results at 0°			
0.0	22.20	KCl	35.83	9.34	KCl
2.45	21.33	"	38.97	8.12	"
4.65	20.43	"	39.75	7.27	"
7.54	19.12	"	41.75	6.74	"
10.08	18.40	"	45.01	5.89	"
12.51	17.12	"	47.59	5.48	"
14.89	16.48	"	49.56	4.67	"
18.17	15.18	"	51.89	4.07	KI + KCl
22.21	13.71	"	51.88	4.07	"
27.02	12.06	"	57.70	0.0	KI
31.51	10.59	"			

Gms. KI per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase
Results at 25°		
0.0	26.30	KCl
3.07	24.55	"
4.73	23.86	"
7.19	22.57	"
8.16	22.10	"
8.64	21.77	"
11.80	21.20	"
13.56	19.67	"
15.27	18.90	"
19.65	16.90	"
25.04	15.25	"
29.97	12.80	"
31.60	12.22	"
33.81	11.61	"
36.13	10.52	"
38.74	9.77	"
41.38	8.55	"
43.02	8.01	"
45.14	7.38	"
47.19	6.63	"
49.02	6.10	"
53.12	5.01	"
54.54	4.53	KI + KCl
54.52	4.57	"
54.67	4.60	"
54.60	4.52	"
54.57	4.53	"
59.76	0.0	KI
Results at 50°		
0.0	30.10	KCl
5.01	27.49	"
7.52	26.34	"
10.02	24.85	"
15.39	22.89	"
19.07	19.98	"
27.87	15.79	"
35.03	13.15	"
40.01	11.13	"
48.82	7.75	"
54.97	5.73	"
57.34	5.04	KI + KCl
57.40	4.85	"
57.46	4.92	"
57.40	4.92	"
62.70	0.0	KI
Results at 75°		
0.0	33.20	KCl
4.00	31.06	"
9.29	27.67	"
15.04	25.14	"
18.36	23.05	"
20.02	22.09	"
24.98	19.56	"
30.13	17.15	"
35.85	14.01	"
40.93	12.54	"
45.02	9.40	"
49.84	8.70	"
55.86	6.65	"
58.00	5.43	KI + KCl
59.01	5.42	"
59.06	5.46	"
59.02	5.44	"
65.30	0.0	KI

Empirical equations for the solubility of potassium chloride as a function of the concentration of potassium iodide in solution at 0°, 25°, 50°, and 75° are given by Zhandov, 1948a.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - AMMONIUM CHLORIDE - WATER AT 20°

(Dolique and Pauc, 1947)

The authors do not mention the solid solutions found by other workers (Vol. I, p. 767-8) and below, but the compositions of saturated solutions agree with those previously found.

Gms. per 100 gms. H_2O		Density d_4^{20}	Gms. per 100 gms. H_2O		Density d_4^{20}
KCl	NH_4Cl		KCl	NH_4Cl	
0.0	37.4	1.076	15.8	30.92	-
3.35	35.93	1.089	16.26	29.48	1.130
6.72	35.6	1.098	20.15	20.59	-
14	31.8	1.124	20.74	20.22	-
15.3	31.9	1.132*	34.39	0.0	1.173

*(Invariant)

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - AMMONIUM CHLORIDE - WATER

(Jarlykoff, 1934)

Gms. KCl per 100 gms. H_2O	Gms. NH_4Cl per 100 gms. H_2O	Density	Solid Phase
	Results at 0°		
28.10	0.0	1.1642	KCl
20.80	10.37	1.1316	$x KCl \cdot y NH_4Cl$
13.69	24.07	1.1162	$x KCl \cdot y NH_4Cl + w NH_4Cl \cdot z KCl$
11.04	25.65	1.1057	$w NH_4Cl \cdot z KCl$
0.0	29.9	1.066	NH_4Cl
	Results at 25°		
36.40	0.0	1.1775	KCl
26.71	12.24	1.1540	$x KCl \cdot y NH_4Cl$
27.37	21.60	1.1417	"
16.40	32.0	1.1322	"
15.73	32.70	1.1322	$x KCl \cdot y NH_4Cl + w NH_4Cl \cdot z KCl$
14.64	32.9	1.1282	$w NH_4Cl \cdot z KCl$
0.0	40.1	1.064	NH_4Cl
	Results at 45°		
41.13	0.0	1.1956	KCl
35.6	7.62	1.1775	$x KCl \cdot y NH_4Cl$
26.9	21.90	1.1506	"
17.51	39.70	1.350	$x KCl \cdot y NH_4Cl + w NH_4Cl \cdot z KCl$
7.67	44.1	1.1075	$w NH_4Cl \cdot z KCl$
0.0	48.0	1.085	NH_4Cl
	Results at 65°		
46.9	0.0	1.209	KCl
35.76	15.60	1.1788	$x KCl \cdot y NH_4Cl$
30.3	27.30	1.526	"
18.8	48.5	1.1390	$x KCl \cdot y NH_4Cl + w NH_4Cl \cdot z KCl$
0.0	56.5	1.086	NH_4Cl
	Results at 90°		
52.5	0.0	1.2184	KCl
39.3	20.5	1.1760	$x KCl \cdot y NH_4Cl$
32.4	36.9	1.1547	"
21.5	59.31	1.1570	$x KCl \cdot y NH_4Cl + w NH_4Cl \cdot z KCl$
18.0	60.9	1.1450	$w NH_4Cl \cdot z KCl$
0.0	68.1	1.1020	NH_4Cl

EQUILIBRIUM IN THE SYSTEM KCl + NH_4Cl + H_2O AT 25°

(Flatt and Burkhardt, 1944)

The results agree with those found by previous workers (Vol.I, p.767-8)

Moles NH_4Cl per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Moles NH_4Cl per 100 moles Solid Phase	Moles NH_4Cl per 100 moles Dissolved Salts	Moles H_2O per mole of Dissolved Salts	Moles NH_4Cl per 100 moles Solid Phase
0.0	11.40	0.0	70.5	7.07	22.4
27.9	10.00	3.0	73.3	6.89	26.6
32.2	9.58	2.5	74.2	6.67	98.6
52.4	8.47	9.2	76.1	6.78	98.5
56.2	8.05	11.0	84.6	7.00	99.1
68.5	7.13	19.4	100.0	7.47	100.0

THE SYSTEM KCl + $NH_4NO_3 \rightleftharpoons NH_4Cl + KNO_3$ IN WATER

(Bergman, 1938)

The data are given for the sections KCl + NH_4NO_3 + H_2O and KNO_3 + NH_4Cl + H_2O from 20° to 30°, and essentially supplement those of other workers (Vol, I, p. 757). Below 24.4° the stable pair is KNO_3 + NH_4Cl, and the solubility of each is given below. The eutectic is at -16.4° with KNO_3 + NH_4Cl + Ice as saturating phases. The results are also given on a molar basis.

Gms. per 100 gms. Sat. Sol. KNO_3	Gms. per 100 gms. Sat. Sol. NH_4Cl	Solid Phase
Results at -15°		
0.0	18.7	NH_4Cl
4.9	19.4	"
6.7	19.2	NH_4Cl + KNO_3
6.5	18.7	KNO_3
6.0	17.5	KNO_3 + Ice
4.95	17.65	Ice
0.0	18.5	"
Results at -10°		
0.0	20.8	NH_4Cl
4.8	20.1	"
9.2	19.9	KNO_3 + NH_4Cl
8.75	18.25	KNO_3
6.75	11.7	KNO_3 + Ice
5.25	12.0	Ice
0.0	13.3	"
Results at 0°		
0.0	22.9	NH_4Cl
4.7	22.2	"
14.0	21.1	KNO_3 + NH_4Cl
13.4	17.3	KNO_3
21.1	8.75	"
11.6	0.0	"
Results at 10°		
0.0	25.0	NH_4Cl
4.55	24.1	"
18.05	22.4	NH_4Cl + KNO_3
17.9	20.4	KNO_3
18.0	16.35	"
17.85	8.2	"
17.7	0.0	"
Results at 20°		
0.0	27.2	NH_4Cl
4.4	25.9	"
20.3	22.7	"
21.9	22.6	NH_4Cl + KNO_3
22.2	19.4	KNO_3
22.6	15.4	"
23.4	7.8	"
23.4	0.0	
Results at 30°		
0.0	29.3	NH_4Cl
4.3	28.0	"
20.0	24.1	"
24.0	23.5	"
25.7	23.2	NH_4Cl + KNO_3
25.7	22.3	KNO_3
27.0	14.6	"
26.4	18.4	"
29.0	7.1	"
31.2	0.0	

The system K_2CrO_4 - KCl - KNO_3 - H_2O was studied from the eutectic to 40° by Palkin and Bogoyavlenskii, 1941. No compounds, hydrates, nor solid solutions are found in the system.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - POTASSIUM PERRHENATE - WATER

(Smith, 1946)

Results at 0°			Results at 30°		
Gms. $KReO_4$ per 100 gms. H_2O	Gms. KCl per 100 gms. H_2O	Solid Phase	Gms. $KReO_4$ per 100 gms. H_2O	Gms. KCl per 100 gms. H_2O	Solid Phase
0.36	0.0	$KReO_4$	1.47	0.0	$KReO_4$
.027	9.51	"	0.423	1.63	"
.023	20.63	"	.173	1.53	"
.022	28.05	$KReO_4$ + KCl	.114	13.84	"
.017	28.10	KCl	.072	37.47	$KReO_4$ + KCl
.007	28.04	"	.000	37.42	KCl
.000	28.02	"			

The system KCl - KH_2PO_4 - H_2O was studied by Polosin and Shakhparonov, 1939 from the eutectic to +35°. No compounds were formed. The eutectic temperature is -10.8° and the saturated solution contains 18.84% KCL and 2.31% KH_2PO_4.

Data for the composition of saturated solutions containing KCl and $NH_4H_2PO_4$, with solid solutions (K, NH_4)Cl and (K, NH_4)H_2PO_4 as saturating phases are given by Polosin and Shakhparonov, 1947 from -11.2 to 35°. Cl

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - MAGNESIUM CHLORIDE - WATER AT 35° AND 75°

(Lightfoot and Prutton; 1946, 1947)

Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. KCl per 100 gms. Sat. Sol.	Solid Phase
	Results at 35°	
0.0	28.04	KCl
3.70	23.53	"
9.41	16.95	"
15.24	11.42	"
21.41	6.85	"
27.32	3.80	KCl + $KCl \cdot MgCl_2 \cdot 6H_2O$
27.34	3.81	"
30.40	1.38	$KCl \cdot MgCl_2 \cdot 6H_2O$
33.63	0.38	"
36.17	.14	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $MgCl_2 \cdot 6H_2O$
36.28	0.0	$MgCl_2 \cdot 6H_2O$
	Results at 75°	
0.0	33.16	KCl
7.51	23.98	"
12.65	18.36	"
20.95	10.73	"
28.43	5.88	"
29.26	5.[illegible]	KCl + $KCl \cdot MgCl_2 \cdot 6H_2O$
29.25	5.57	"
30.08	4.54	$KCl \cdot MgCl_2 \cdot 6H_2O$
31.75	3.[illegible]	"
33.57	1.73	"
35.84	0.81	"
37.04	0.58	"
38.85	0.[illegible]	$KCl \cdot MgCl_2 \cdot 6H_2O$ + $MgCl_2 \cdot 6H_2O$
38.86	0.32	"
39.12	0.0	$MgCl_2 \cdot 6H_2O$

Data for the system $KCl - MgCl_2 - H_2O$ up to 200° is given by d'Ans and Sypiena, 1942. Further data at 35° and 55° are reported by Zorkin and Petuthova, 1940.

The reciprocal salt pair $2KCl + MgSO_4 \rightleftharpoons K_2SO_4 + MgCl_2$ was studied in detail at 25° by Kurnakov and Shoikhet, 1938 and the equilibrium diagram is also given by Kurnakov and Loukianova, 1938.

Data for the system $KCl - NaCl - MgSO_4 - H_2O$ at 35° and 50° are given by Zorkin and Petukhova, 1940.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - POTASSIUM SULFATE - WATER AT 20°

(Dolique and Paue, 1947)

Gms. per 100 gms. H_2O		Density d_4^{20}	Solid Phase
KCl	K_2SO_4		
0.0	11.11	1.081	K_2SO_4
7.04	5.7	1.085	"
12.9	5.1	1.100	"
20	3.46	1.129	"
29.92	2.01	1.171	"
34.5	3.18	1.181	K_2SO_4 + KCl
34	1.56	1.179	KCl
34.39	0.0	1.173	"

Cl The equilibrium at -5°, 25°, and 75° in the quaternary system K_2SO_4 + NaCl + H_2O were determined by Zaslavsky, Sinani, and Sokolova, 1938.

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - UREA - WATER .

(Polosin and Ozolin, 1947)

The system was also studied by Bochovkin and Bochovkina, 1947 with results which differ from those below. According to B. and B. the eutectic solution contains 15.9% KCl and 26.1% urea at -16.9°, and is in equilibrium with ice, -KCl and -urea. They found only -urea to be stable in mixtures which contained excess solid KCl.

The results below are also given in moles per 1000 moles of water and moles per 100 moles of dissolved salts.

Gms. KCl per 100 gms. S.S.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase	Gms. KCl per 100 gms. S.S.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase
Results at -15°			Results at 0°		
16.00	15.85	Ice + α-KCl	21.65	0.0	α-KCl
15.90	16.80	α-KCl	20.10	8.00	"
14.10	25.75	"	18.40	16.30	"
14.10	28.00	α-KCl + α-$CO(NH_2)_2$	16.65	24.95	"
13.15	28.05	α-$CO(NH_2)_2$	15.55	29.10	α-KCl + β-KCl
12.10	28.30	"	14.90	34.10	β-KCl
7.90	29.00	α-$CO(NH_2)_2$ + Ice	14.80	34.40	"
8.50	27.40	Ice	14.60	35.40	β-KCl + α-$CO(NH_2)_2$
10.40	24.35	"	11.05	36.30	α-$CO(NH_2)_2$
15.00	17.00	"	4.90	38.40	"
			0.0	40.00	"

Gms. KCl per 100 gms. S.S.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase
Results at 10°		
23.45	0.0	α-KCl
20.10	8.00	"
18.40	16.30	"
16.65	24.95	α-KCl + β-KCl
15.55	29.10	β-KCl
14.90	34.10	"
14.80	34.40	"
14.60	35.40	β-KCl + β-$CO(NH_2)_2$
11.05	36.30	β-$CO(NH_2)_2$
4.90	38.40	"
0.0	40.00	"
Results at 25°		
26.45	0.0	β-KCl
24.50	7.55	"
22.30	15.55	"
20.10	24.00	"
17.70	33.00	"
16.90	36.60	"
15.60	42.30	"
14.40	47.80	β-KCl + β-$CO(NH_2)_2$
9.10	50.00	β-$CO(NH_2)_2$
3.80	52.70	"
0.0	54.60	"
Results at 30°		
27.10	0.0	β-KCl
25.20	7.45	"
23.05	15.40	"
20.80	23.80	"
18.30	32.80	"
17.50	36.30	"
16.00	42.00	"
14.60	47.80	"
14.30	50.20	β-KCl + β-$CO(NH_2)_2$
9.50	52.40	β-$CO(NH_2)_2$
3.50	55.60	"
0.0	57.40	γ-$CO(NH_2)_2$
Results at 40°		
28.30	0.0	β-KCl
26.60	7.35	"
24.50	15.10	"
22.10	23.35	"
19.50	32.30	"
18.65	35.80	"
16.90	41.55	"
15.50	47.40	"
14.00	55.20	β-KCl + β-$CO(NH_2)_2$
10.40	57.20	β-$CO(NH_2)_2$
3.10	61.20	γ-$CO(NH_2)_2$
0.0	62.25	"

Cl

Invariant Points

t°	Gms. KCl per 100 gms. Sat. Sol.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase
(-10.6)	19.80	0.0	Ice + α-KCl
(22.1)	26.20	0.0	α-KCl + β-KCl
(-10.9)	0.0	32.90	Ice + α-$CO(NH_2)_2$
(1.1)	0.0	40.70	β-$CO(NH_2)_2$ + α-$CO(NH_2)_2$
(29.2)	0.0	57.20	β-$CO(NH_2)_2$ + γ-$CO(NH_2)_2$
(-19.4)	13.45	26.15	Ice + α-KCl + α-$CO(NH_2)_2$
(-7.9)	14.50	31.50	α-KCl + β-KCl + α-$CO(NH_2)_2$
(8.1)	14.60	39.20	β-KCl + α-$CO(NH_2)_2$ + γ-$CO(NH_2)_2$

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHLORIDE - SODIUM CHLORIDE - LITHIUM CHLORIDE - WATER

(Yanatieva, 1947)

t°	Gms. per 100 gms. of Sat. Sol. KCl	NaCl	LiCl	Density	Solid Phase
0	1.43	0.73	36.80	1.252	KCl + NaCl + $LiCl \cdot H_2O$
25	9.76	13.98	6.05	1.217	KCl + NaCl
25	6.14	5.25	16.95	1.189	"
25	3.32	0.80	44.20	1.322	KCl + NaCl + $LiCl \cdot H_2O$
50	13.00	12.77	6.15	1.233	KCl + NaCl
50	8.49	6.94	15.71	1.207	"
50	6.03	1.09	45.59	1.359	KCl + NaCl + $LiCl \cdot H_2O$

The 100° isotherm of the system KCl - RbCl - MgCl - H_2O was determined by Makarov, Perelman, and Logkova, 1941.

The diagram for the system K^+, NH_4^+, Na^+, Cl^-, NO_3^- - H_2O at 20° is given by Schutze, Piechowicz, and Wahl, 1943. The invariant solutions are as follows:

Moles per 1000 moles of Water					Solid Phases
K^+	NH_4^+	Na^+	Cl^-	NO_3^-	
26.1	66.9	73.1	166.1	-	$KCl + NH_4Cl + NaCl$
91	320	160	-	571	$KNO_3 + NH_4NO_3 + NaNO_3$
65.6	99.7	104.6	158.7	111.2	$KCl + NH_4Cl + NaCl + KNO_3$
80	202	181	114	349	$NH_4Cl + NaCl + NaNO_3 + KNO_3$
95	415	172	100	582	$NH_4Cl + KNO_3 + NH_4NO_3 + NaNO_3$

Cl The distribution of bromide ions between solid phases and liquid phases in systems containing Mg^{++}, Cl^-, K^+ ; Na^+ and H_2O was studied by Cirkov and Schnee, 1939. The effect of the rate of crystallization on the distribution was also determined.

The distribution of micro amounts of Br^- between the solution and solid phases during isothermal evaporation was studied by Cirkov, 1944, in the following systems: KCl + H_2O at 25°, 107°; KCl + NaCl + H_2O at 25°; KCl + I^- + H_2O at 25°; KCl + NaCl + I^- + H_2O at 25°; KCl + $MgCl_2$ + H_2O at 35°.

The specific volumes and heat capacities of solutions of KCl + NH_4NO_3 are given by Rutskov, 1948.

SOLUBILITY OF POTASSIUM CHLORIDE IN AQUEOUS ETHANOL SOLUTIONS

(Achoumov, 1939)

Compositions of the saturated solutions:

Results at 0°		Results at 25°	
Gms. per 1000 gms. H_2O		Gms. per 1000 gms. H_2O	
C_2H_5OH	KCl	C_2H_5OH	KCl
0.0	285.2	0.0	359.7
10.28	278	10.28	353.8
20.54	271.1	20.54	346.2
41.07	256.5	41.07	333.8
123.2	208.8	82.14	315.6
		205.4	258.9

SOLUBILITY OF POTASSIUM CHLORIDE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent	Gms. KCl per 100 gms. Solvent
Ethylenediamine	0.014
Monoethanolamine	0.27
Ethylene Glycol	5.18

- 100 gms. of a saturated solution in 50% ethyl alcohol contains 5.15 gms. KCl at 20°.
- 100 gms. of a saturated solution in 50% ethyl alcohol saturated with benzene contains 5.50 gms. KCl at 20°. (Grinberg and Zemlyakova, 1948)

A mixture of equal volumes of ethyl ether and water, when saturated with HCl at 0° dissolves 0.056 gms. KCl per 100 gms. of mixture. (Fischer and Seidel, 1941)

SOLUBILITY OF POTASSIUM CHLORIDE IN IODINE MONOCHLORIDE

(Cornog and Bauer, 1942)

t°	Gms. KI per 100 gms. ICl	Solid Phase	t°	Gms. KI per 100 gms. ICl	Solid Phase
15	4.70	$KCl \cdot 2ICl$	45*	6.95	$KCl \cdot ICl$
20	4.90	"	50	7.20	"
25	5.20	"	55	7.40	"
30	5.55	"	60	7.70	"
35	5.95	"	65	8.05	"
40	6.45	"			
40	6.80**	$KCl \cdot ICl$			

* = Transition temperature
** = Metastable

SOLUBILITY OF KCl IN LIQUID SULFUR DIOXIDE AT 25° Cl

(Shatenstein and Viktorov, 1937)

100 gms. of a saturated solution of KCl in SO_2 contain 0.0126 gms. KCl at 25°.

The solubility of KCl in $SbCl_3$ at its melting point (520° - 530°) is given by Zouravlev, 1939.

Melting point data have been determined for the following systems:

$KCl + KVO_3$	(Schmitz-Dumont and Schmitz, 1944)
$KCl + ZnCl_2$	(Ugai and Shatillo, 1949)
	(Nikonova, Pavlenko, and Bergman, 1941)
$KCl + PbCl_2$	(Ugai and Shatillo, 1949)
$KCl + ZnCl_2 + PbCl_2$	"
$KCl + ZnSO_4$	(Luzhnaya and Vereshemina, 1949)
$KCl + ZnSO_4 + NaCl$	"
$KCl + ZnCl_2 + NaCl$	"
	(Nikonova, Pavlenko, and Bergman, 1941)
$KCl + KClO_3$	(Falkin, 1948)
$KCl + KNO_3$	"
$KCl + KNO_3 + KClO_3$	" (Fedotov, 1941)
$KCl + MgCl_2$	(Klemm, Beyersdorfer, and Oryschkewitsch, 1948)
$KCl + MgCl_2 + NaCl$	(Imatomi, 1940)
$KCl + KF + K_2SO_4$	(Mukimov, 1940)
$KCl + NaF + K_2SO_4$	(Volkov and Bergman, 1940)
$KCl + NaF + Na_2CO_3$	"
$KCl + KF$	(Volkov and Bergman, 1940a)
$KCl + K_2CO_3$	"
$KCl + KF + K_2CO_3$	"
$2KCl + CaF_2 \quad 2KF + CaCl_2$	(Krauze and Bergman, 1942)

Reactions in the systems KCl + RbF and KCl + CsF at temperatures below the melting points were studied by Link and Wood, 1940.

C1O POTASSIUM CHLORATE $KClO_3$

SOLUBILITY OF POTASSIUM CHLORATE IN DEUTERIUM OXIDE SOLUTIONS AT 5°

(Noonan, 1948)

Mole % D_2O	Moles $KClO_3$ per 100 moles $H_2O + D_2O$
0.0	0.5845
91.43	.5182
100.0	.5120

INVARIANT POINTS IN THE SYSTEM $KClO_3 + NaClO_3 + H_2O$

(Muntner and Brown, 1943)

t°	Saturated Solution Wt. % $NaClO_3$	Saturated Solution Wt. % $KClO_3$	Solid Phase
0	44.21	0.44	$NaClO_3 + KClO_3$
40	51.75	3.41	"

SOLUBILITY OF POTASSIUM CHLORATE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent	Gms. $KClO_3$ per 100 gms. Solvent
Ethylenediamine	0.145
Monoethanolamine	0.30
Ethylene Glycol	1.21

Melting points in the system $KClO_3 + KNO_3$ were determined by Falkin, 1948.

C1O POTASSIUM PERCHLORATE $KClO_4$

EQUILIBRIUM IN THE SYSTEM POTASSIUM PERCHLORATE - POTASSIUM PERMANGANATE - WATER AT 25°

(Greenberg and Walden, 1940)

The mixtures were heated, and equilibrium was approached from supersaturation. Equilibrium was attained in two weeks, providing the solid phase was ground in an agate mortar a few days after preparation, otherwise 1½ months were required. The solid phases were analyzed by the wet residue method, and the lattice constants were determined by X-Ray analysis.

Gms. $KMnO_4$ per 100 gms. Sat. Sol.	Gms. $KClO_4$ per 100 gms. Sat. Sol.	Wt. % $KMnO_4$ in Solid Solution
0.4712	1.868	1.2
2.065	1.381	7.7
2.651	1.230	11.8
2.628	1.245	12.0
4.009	0.9777	26.8
4.573	.8434	38.2
4.864	.7816	44.4
5.698	.5872	68.0
5.732	.5548	70.2
6.333	.3582	84.5

ClO

SOLUBILITY OF POTASSIUM PERCHLORATE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent	Gms. $KClO_4$ per 100 gms. Solvent
Ethylenediamine	2.81
Monoethanolamine	1.36
Ethylene Glycol	1.03

POTASSIUM CHROMATE K_2CrO_4

CrO

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHROMATE - SODIUM CHROMATE - WATER AT 25°

(Makarov and Druzhinin, 1937)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Solid	
Na_2CrO_4	K_2CrO_4	Na_2CrO_4	K_2CrO_4
45.76	0.0		
41.49	5.49	60.0	0.0
35.00	11.75	29.50	70.50
34.35	13.20	25.90	74.10
27.21	14.92	25.60	74.40
25.15	15.27	23.00	77.00
22.97	16.86	23.50	76.50
16.49	21.40	23.00	77.00
12.33	25.62	22.00	78.00
9.46	30.00	21.50	78.50
8.24	30.82	20.75	79.25
8.08	32.04	21.00	79.00
4.25	35.77	0.0	100.0
0.0	39.52		

Results of M. and D. in Moles

Moles per 100 moles Dissolved Salts		Moles per 100 moles Solid	
Na_2CrO_4	K_2CrO_4	Na_2CrO_4	K_2CrO_4
100.0	0.0	} (Pure $Na_2CrO_4 \cdot 6H_2O$)	
90.05	9.95		
76.70	23.30	33.30	66.70
76.09	23.91	29.52	70.48
69.61	30.39	29.30	70.70
66.38	33.62	26.90	73.10
62.01	37.99	26.61	73.39
48.01	51.99	26.85	73.15
36.58	63.42	25.25	74.75
27.40	72.60	24.72	75.28
24.28	75.72	24.00	76.00
23.19	76.81	24.16	75.84
12.45	87.55	} (Pure K_2CrO_4)	
0.0	100.0		

CrO

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHROMATE, POTASSIUM NITRATE AND WATER

(Ravich and Frolova, 1944)

t°	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. K_2CrO_4 per 100 gms. Sat. Sol.	Solid Phase
-12.1	2.31	35.34	Ice + KNO_3 + K_2CrO_4
-6.2	5.73	18.87	KNO_3 + Ice
-5.8	5.57	18.33	Ice
-4.6	4.62	15.23	"
-2.6	2.64	8.71	"
-4.8	5.93	19.53	KNO_3
-1.8	6.52	21.48	"
+2.0	7.24	23.83	"
4.4	7.58	24.97	"
0	9.20	9.54	"
	6.94	19.98	"
	5.50	32.56	"
	4.72	34.66	KNO_3 + K_2CrO_4
	3.01	35.68	K_2CrO_4
25	22.26	8.25	KNO_3
	17.79	17.76	"
	12.54	29.32	"
	10.28	32.31	KNO_3 + K_2CrO_4
	6.01	35.32	K_2CrO_4
50	40.45	6.39	KNO_3
	34.17	13.92	"
	25.48	26.46	KNO_3 + K_2CrO_4
	14.44	32.77	K_2CrO_4
	7.23	36.82	"
96.5	56.43	10.64	KNO_3 + K_2CrO_4
116	71.15	5.49	"

EQUILIBRIUM IN THE SYSTEM POTASSIUM CHROMATE - POTASSIUM SULFATE - WATER AT 25°

(Makarov and Druzhinin, 1937)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Solid	
K_2SO_4	K_2CrO_4	K_2SO_4	K_2CrO_4
0.0	39.52	0.0	100.0
1.11	36.18	12.60	87.40
1.51	33.91	32.50	67.50
1.88	30.91	45.00	55.00
2.66	25.75	66.90	33.10
3.49	23.20	91.50	8.50
5.47	15.53	99.20	0.80
8.75	4.95	99.80	0.20
10.76	0.0	100.0	0.0

Moles per 100 moles of Dissolved Salts		Moles per 100 moles Solid	
K_2SO_4	K_2CrO_4	K_2SO_4	K_2CrO_4
0.0	100.0	0.0	100.0
3.30	96.70	18.84	86.16
4.73	95.27	34.92	65.08
6.35	93.65	47.69	52.31
10.32	89.68	69.25	30.75
14.35	85.65	92.30	7.70
28.18	71.82	99.28	0.72
66.40	33.60	99.82	0.18
100.0	0.0	100.0	0.0

Data for the reciprocal salt pair $K_2CrO_4 + Na_2SO_4 \rightleftharpoons Na_2CrO_4 + K_2SO_4$ in water at 25° are given by Makarov and Druzhinin, 1937.

Melting points in the system $K_2CrO_4 + KNO_3$ are given by Kitrov, 1949.

POTASSIUM DICHROMATE $K_2Cr_2O_7$

Cr_2O_7

SOLUBILITY OF POTASSIUM DICHROMATE IN DEUTERIUM OXIDE SOLUTIONS

(Noonan, 1948)

t°	Mole % D_2O	Moles $K_2Cr_2O_7$ per 100 moles $H_2O + D_2O$	t°	Mole % D_2O	Moles $K_2Cr_2O_7$ per 100 moles $H_2O + D_2O$
5	0.0	0.3645	25	0.0	0.9136
	91.83	.2525		48.5	.788
	100.0	.2425		91.8	.6903
15	0.0	.5977		98.0	.6781
	91.56	.4286		100.0	.6720
	100.0	.4130	35	0.0	1.3252
				91.83	1.0454
				100.0	1.0205

Data for the reciprocal salt pair $K_2CrO_4 + Na_2SO_4 \rightleftharpoons K_2SO_4 + Na_2CrO_4$ in water at 25° are given by Druzhinin, 1938. The compounds $2K_2CrO_4 \cdot Na_2CrO_4$ and $2K_2SO_4 \cdot Na_2SO_4$ are isomorphous.

Melting points have been determined in the following systems:

$K_2Cr_2O_7 + Na_2Cr_2O_7$ Evdokimova and Bergman, 1945

$K_2Cr_2O_7 + 2NaNO_3 \rightleftharpoons Na_2Cr_2O_7 + 2KNO_3$ "

$K_2Cr_2O_7 + 2NaCl \rightleftharpoons Na_2Cr_2O_7 + 2KCl$ "

F POTASSIUM FLUORIDE KF

EQUILIBRIUM IN THE SYSTEM POTASSIUM FLUORIDE - HYDROGEN FLUORIDE - WATER

(Tananaev, 1938)

The results agree well with those of Ditte (Vol. I, p. 803) at 21°.

Gms. per 100 gms. Sat. Sol.		Moles per 100 moles Sat. Sol.		Solid Phase
KF	HF	KF	HF	
	Results at 0°			
42.77	0.0	18.80	0.0	$KF \cdot 2H_2O$
44.15	0.36	19.68	0.46	$KF \cdot 2H_2O + KF \cdot HF$
41.00	0.38	17.72	0.48	$KF \cdot HF$
39.66	0.43	16.93	0.53	"
29.75	0.71	11.61	0.81	"
27.33	0.95	10.45	1.05	"
24.08	1.25	8.96	1.35	"
22.86	1.41	8.42	1.51	"
20.12	1.89	7.26	1.98	"
17.85	2.40	6.34	2.41	"
14.72	4.15	5.10	4.18	"
14.08	5.23	4.86	5.24	"
14.63	6.43	5.09	6.48	"
16.30	10.43	5.71	10.71	"
21.50	17.71	7.99	19.12	"
25.23	21.27	9.70	23.80	"
27.89	24.07	11.03	27.66	
31.60	26.87	12.96	32.06	$KF \cdot 2HF$
30.72	27.57	12.52	32.65	"
29.86	29.20	12.10	34.39	"
29.81	32.33	12.12	38.20	"
29.40	34.83	11.95	41.14	"
27.95	37.14	11.22	43.43	$2KF \cdot 5HF$
27.29	38.52	10.94	44.83	"
26.77	40.35	10.70	46.88	"
26.66	42.10	10.67	48.96	"
26.42	44.30	10.58	51.56	"
26.82	45.83	10.80	53.64	$KF \cdot 3HF$
25.59	45.09	10.19	52.15	"
24.02	45.42	9.44	51.82	"
22.85	46.75	8.90	52.90	"
22.38	47.50	8.69	53.56	"
22.30	48.16	8.66	54.32	"
20.98	50.74	8.08	56.77	$KF \cdot 4HF$
20.56	50.82	7.89	56.61	"
19.46	51.30	7.40	56.70	

Gms. per 100 gms. Sat. Sol.		Moles per 100 moles Sat. Sol.		Solid Phase
KF	HF	KF	HF	
18.00	52.08	6.77	56.91	$KF \cdot 4HF$
15.87	54.01	5.84	58.16	"
12.50	57.60	4.52	60.55	"
10.68	60.57	3.82	62.98	"
9.86	64.13	3.52	66.52	"
10.30	68.10	3.71	71.20	"
12.01	69.80	4.39	74.14	"
14.17	71.57	5.27	77.57	"
15.85	72.42	6.00	79.65	"
19.84	73.27	7.78	83.50	"
23.62	74.60	9.59	88.08	"
		Results at 20°		F
47.75	0.0	22.08	0.0	$KF \cdot 2H_2O$
47.80	0.27	22.11	0.36	"
47.90	0.72	22.87	0.98	$KF \cdot 2H_2O + KF \cdot HF$
38.30	0.82	16.15	1.00	$KF \cdot HF$
35.47	1.12	14.58	1.36	"
31.00	1.46	12.26	1.69	"
21.53	5.05	7.88	5.37	"
20.50	6.88	7.40	7.20	"
21.47	10.04	7.90	10.74	"
26.70	17.97	10.37	20.27	"
27.70	18.34	10.90	20.85	"
38.00	28.38	16.60	36.00	"
40.67	29.84	18.28	38.96	"
41.57	30.55	18.86	40.30	"
42.94	31.36	19.78	41.98	"
43.41	31.68	20.22	42.88	"
41.70	33.05	19.01	43.81	$KF \cdot 2HF$
42.80	32.25	19.72	43.16	"
41.68	33.14	19.00	43.90	"
40.55	34.00	18.30	44.60	"
39.77	36.54	17.89	47.73	"
40.37	38.82	18.35	51.23	"
37.62	40.18	16.65	51.65	$2KF \cdot 5HF$
35.37	41.90	15.35	52.81	"
34.42	44.20	14.84	55.40	"
34.00	45.27	14.62	56.59	$KF \cdot 3HF$
31.00	47.55	13.02	57.94	"
30.56	47.77	12.76	58.02	"
29.64	48.68	12.30	58.67	"
28.86	49.50	11.90	59.30	"
28.75	50.01	11.83	59.91	"
28.64	50.26	11.80	60.17	$KF \cdot 4HF$
26.04	51.81	10.50	60.70	"
21.36	55.30	8.30	62.43	"
18.67	58.58	7.12	64.88	"
17.64	62.23	6.69	68.66	"
17.45	64.12	6.65	70.75	"
18.36	66.60	7.05	74.29	"
19.20	67.15	7.43	75.52	"

Gms. per 100 gms. Sat. Sol.		Moles per 100 moles Sat. Sol.		Solid Phase
KF	HF	KF	HF	
		Results at 40°		
56.36	0.0	28.58	0.0	$KF \cdot 2H_2O$
58.50	0.30	30.42	0.42	"
59.20	1.37	31.09	2.08	$KF \cdot 2H_2O + KF \cdot HF$
39.70	1.50	16.98	1.86	$KF \cdot HF$
37.28	1.89	15.60	2.28	"
32.28	2.95	13.26	3.50	"
29.72	4.23	11.64	4.82	"
27.60	7.24	10.66	8.12	"
27.10	9.26	10.45	10.37	"
29.12	14.22	11.50	16.30	"
30.75	17.55	14.20	23.56	"
38.40	23.80	16.73	30.12	"
46.07	30.00	21.88	41.40	"
47.80	31.95	23.21	45.08	"
48.83	32.72	24.01	46.73	"
50.71	34.41	25.52	50.31	"
52.60	35.22	27.07	52.68	"
52.80	35.68	27.27	53.53	$KF \cdot HF + KF \cdot 2H_2O$
50.74	36.57	25.62	53.66	$KF \cdot 2HF$
48.87	38.60	24.26	55.67	"
49.15	39.40	24.49	56.92	"
48.92	40.53	24.36	58.70	"
46.24	42.98	22.46	60.64	$2KF \cdot 5HF$
44.70	44.46	21.40	61.84	"
43.40	46.21	20.55	63.58	"
42.75	48.03	20.15	65.81	"
38.17	50.54	17.25	66.31	$KF \cdot 3HF$
37.41	51.38	16.78	66.97	"
37.05	52.04	16.58	67.66	"
36.98	52.50	16.55	68.25	"
34.21	54.20	14.93	68.73	$KF \cdot 4HF$
31.46	55.76	13.40	69.01	"
29.68	56.74	12.45	69.16	"
27.74	58.07	11.44	69.66	"
26.25	60.54	10.72	71.85	"

F

Melting points have been determined in the following systems:

KF + NaF	(Bergman and Dergunov, 1945, 1941a)
	(Bergman and Nagorny, 1943)
KF + MgF_2	(Dergunov and Bergman, 1948)
	(Bergman and Dergunov, 1945)
	(Remy and Seeman, 1940)
KF + RbF	(Dergunov and Bergman, 1948)
KF + LaF_3	(Dergunov, 1948)
KF + YF_3	(Dergunov, 1948)
KF + KVO_3	(Schmitz-Dumont and Schmitz, 1944)
KF + LiF	(Bergman and Dergunov, 1941a)
KF + ThF_4	(Dergunov and Bergman, 1948a)
KF + ThF_4 + RbF	(Dergunov and Bergman, 1948a)
KF + MgF_2 + RbF	(Dergunov and Bergman, 1948)
KF + MgF_2 + NaF	(Bergman and Dergunov, 1945, 1941)
	(Bergman and Pavlenko, 1941)
KF + NaF + LiF	(Bergman and Dergunov, 1941a)

The systems KF + UF_4, KF + ThF_4, and KF + LaF_3 were studied by means of X-rays by Zachariasen, 1948.

The reactions in the solid state below the melting points were studied for the following pairs of salts.

KF + RbCl	KF + CsBr	KF + LiI
KF + RbBr	KF + CsI	KF + NaCl
KF + RbI	KF + LiCl	KF + NaBr
KF + CsCl	KF + LiBr	KF + NaI

Link and Wood, 1940

Densities in the system KF + NaF are given by Abramov, 1939.

POTASSIUM COLUMBIUM FLUORIDE K_2CbF_7, $KCbF_7$ F

SOLUBILITY OF POTASSIUM COLUMBIUM FLUORIDE IN HYDROFLUORIC ACID SOLUTIONS

(Savchenko and Tananaev, 1946, 1947)

Results at 25° (1946)

The System $KCbF_6$ - HF - H_2O

Saturated Solution Wt. %		Solid Phase	Saturated Solution Wt. %		Solid Phase
HF	$KCbF_6$		HF	$KCbF_6$	
40.90	15.79	$KCbF_6$	54.00	15.14	$KCbF_6$
45.00	15.55	"	57.30	14.78	"
47.50	15.50	"	59.00	14.72	"

The System K_2CbF_7 - HF - H_2O

Saturated Solution Wt. %		Solid Phase	Saturated Solution Wt. %		Solid Phase
HF	K_2CbF_7		HF	K_2CbF_7	
1.51	10.44	$K_2CbOF_5 \cdot H_2O$	9.35	11.58	K_2CbF_7
3.61	11.63	"	12.20	8.69	"
4.12	11.76	"	16.34	5.80	"
5.20	12.33	"	19.18	6.19	"
5.30	12.78	"	20.50	6.16	"
6.30	13.14	"	21.60	5.71	"
6.60	13.70	"	27.40	5.71	"
6.94	13.75	K_2CbF_7	31.58	8.11	"
7.16	13.80	"	37.87	12.64	"
7.20	14.16	"	40.32	-	"
8.00	13.85	"			

Above 40.3% HF, the solid phase is $KCbF_6$ and the ratio KF:CbF_5 in solution increases sharply.

Some data for the quaternary systems K_2CbF_7 - KF - HF - H_2O and K_2CbF_7 - K_2TaF_7 - HF - H_2O at 25° are also given.

The system K_2CbF_7 - HF - H_2O at 75° (1947)

Saturated Solution				Solid Phase
Wt. % HF	Wt. % CbF_5	Wt. % KF	$\frac{\text{Mol. KF}}{\text{Mol. } CbF_5}$	
2.70	7.45	-	-	$K_2CbOF_5 \cdot H_2O$
5.00	23.77	14.38	2.00	$K_2CbOF_5 \cdot H_2O$ + K_2CbF_7
6.00	22.52	15.28	2.20	K_2CbF_7
9.60	18.60	-	-	"
11.40	16.50	9.58	1.90	"
15.00	13.80	-	-	"
20.20	11.00	6.80	2.00	"
20.70	11.25	7.19	2.06	"
29.00	11.70	7.12	2.00	"
32.10	13.24	7.87	1.95	"
33.60	17.00	-	-	"

SOLUBILITY OF $K_2CbOF_5 \cdot H_2O$ IN 1% HF SOLUTION

(Meerson, Zverev, and Zubkova, 1939)

Temperature°	20	40	60	75
% $K_2CbOF_5 \cdot H_2O$:	10	19	33	46

Data for the system $K_2CbOF_5 \cdot H_2O$ - K_2TaF_7 - H_2O (+ 1% HF) at 20° and 60° are also given.

F POTASSIUM TANTALUM FLUORIDE K_2TaF_7, $KTaF_6$

SOLUBILITY OF POTASSIUM TANTALUM FLUORIDE IN HYDROFLUORIC ACID SOLUTIONS

(Savchenko and Tananaev, 1946, 1947)

Results at 25° (1946)

The System $KTaF_6$ - HF - H_2O

Saturated Solution Wt. %		Solid Phase	Saturated Solution Wt. %		Solid Phase
HF	$KTaF_6$		HF	$KTaF_6$	
42.40	16.88	$KTaF_6$	59.90	16.53	$KTaF_6$
50.00	16.06	"	63.85	17.21	"
53.15	15.93	"	65.50	17.40	
56.00	15.93	"			

The System K_2TaF_7 - HF - H_2O

Saturated Solution Wt. %		Solid Phase	Saturated Solution Wt. %		Solid Phase
HF	K_2TaF_7		HF	K_2TaF_7	
1.97	0.95	K_2TaF_7	39.49	6.63	K_2TaF_7
9.51	1.26	"	40.90	8.88	"
19.54	2.00	"	42.64	10.16	"
28.20	3.30	"	42.80	10.55	"
32.82	3.95	"	44.00	11.28	"
33.86	4.16	"	44.56	12.56	"
36.14	4.85	"	44.64	12.77	"
37.26	5.71	"	45.29	14.90	"

Above 45.3% HF, the reaction $2KTaF_6 \rightleftharpoons K_2TaF_7 + TaF_5$ proceeds to the left and the solid phase becomes $KTaF_6$. (The ratio $KF:TaF_5$ in solution increases sharply) This new curve was followed up to 69% HF.

The system K_2TaF_7 - HF - H_2O at 75° (1947)

Saturated Solution				Solid Phase
Wt. % HF	Wt. % TaF_5	Wt. % KF	Mol. KF / Mol. TaF_5	
2.70	3.20	1.52	2.25	K_2TaF_7
4.86	3.05	1.37	2.11	"
7.12	3.25	-	-	"
11.80	3.48	1.65	2.18	"
21.52	5.15	-	-	"
30.00	6.74	-	-	"
35.50	10.87	4.69	2.08	"

SOLUBILITY OF K_2TaF_7 IN 1% HF SOLUTION
(Meerson, Zverev, and Zubkova, 1939)

Temperature°	20	40	60	75
% K_2TaF_7:	0.8	1.6	3.1	4.2

POTASSIUM Silico FLUORIDE K_2SiF_6 F

SOLUBILITY OF POTASSIUM SILICO FLUORIDE IN WATER
(Ryss, 1947)

Each figure is the average of many determinations. The results are in fair agreement with those of Carter (Vol. I, p. 810).

Temperature°	20	40	60	100
Gms. K_2SiF_6 per 100 gms. H_2O:	0.113	0.220	0.377	0.82 (Approx.)

POTASSIUM IODIDE KI I

SOLUBILITY OF POTASSIUM IODIDE IN WATER AND DEUTERIUM OXIDE
(Eddy and Menzies, 1940)

t°	Gms. KBr per 100 gms. H_2O	t°	Gms. KBr per 100 gms. D_2O	t°	Gms. KBr per 100 gms. D_2O	t°	Gms. KBr per 100 gms. D_2O
6.2	132.7	0	97.3	55	143.1	105	180
11.2	136.7	5	102.2	60	146.9	110	183.5
56.7	173	10	107.0	65	150.5	115	187
		15	111.7	70	154.3	120	190.5
		20	116.1	75	158	125	194
		25	120.4	80	161.5	130	198
		30	124.5	85	165	135	202
		35	128.4	90	169	140	205
		40	132.1	95	172.5	145	209
		45	135.8	100	176	150	213
		50	139.4				

SOLUBILITY OF POTASSIUM IODIDE IN POTASSIUM HYDROXIDE SOLUTIONS AT 20°

(Kirschman and Pomeroy, 1948)

The data differ from those of Bronsted (Vol. I, p. 814) whose values are all higher. The KOH contained about 1% K_2CO_3, which was expressed as KOH in the data below.

Gm. moles KOH per liter Sat. Sol.	Gm. moles KI per liter Sat. Sol.	Density	Gm. moles KOH per liter Sat. Sol.	Gm. moles KI per liter Sat. Sol.	Density
14.35	0.556	1.593	5.853	2.634	1.540 e
13.28	.651	1.576	4.753	3.145	1.556 e
12.51	.759	1.562 e	4.111	3.485	1.569 e
11.05	.981	1.538 e	4.000	3.525	1.571 e
10.53	1.107	1.533 e	2.405	4.454	1.616 e
8.814	1.541	1.524 e	1.860	4.818	1.635 e
8.161	1.733	1.524 e	1.358	5.132	1.654 e
7.050	2.171	1.529 e	0.783	5.539	1.677 e
6.624	2.292	1.532 e	0.0	6.089	-
6.453	2.369*	1.534 e			

* Contained 0.40 N K_2CO_3

e Estimated by plotting the data given by the authors.

SOLUBILITY OF POTASSIUM IODIDE IN SODIUM HYDROXIDE SOLUTIONS AT 20°

(Kirschman and Pomeroy, 1944)

Moles NaOH per liter of Sat. Sol.	Moles KI per liter of Sat. Sol.	Density	Moles NaOH per liter of Sat. Sol.	Moles KI per liter of Sat. Sol.	Density
0.0	6.09	1.716	6.78	2.75	1.543
0.95	5.48	1.674	7.77	2.42	1.532
1.34	5.26	1.661	8.68	2.18	1.531
2.57	4.58	1.624	10.06	1.81	1.526
3.60	4.06	1.597	10.80	1.67	1.530
4.77	3.53	1.573	13.45	1.29	1.540
5.04	3.44	1.568	16.22	1.03	1.569
5.20	3.35	1.564	16.50	1.03	1.583

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE - IODINE - WATER

(Briggs, Clack, Ballard, and Sassaman, 1940)

The authors' data confirm the findings of Grace (Vol. I, p. 660) and of Foote and Chalker, (Vol. I, p. 813), which indicated the existence of two polyiodide compounds in the system. The older work of Parsons and Whittemore (Vol. I, p. 599) who thought the system to be simple, is shown to have been incorrectly interpreted by those authors.

Gms. KI per 100 gms. Sat. Sol.	Gms. I per 100 gms. Sat. Sol.	Solid Phase
Results at 0°		
55.86	0.0	KI
51.43	10.21	"
46.01	23.10	"
40.34	35.23	"
35.96	45.62	"
35.20	47.50	"
34.92	48.62	"
34.81	48.76	$KI + KI_3 \cdot 2H_2O$
34.27	49.39	$KI_3 \cdot 2H_2O$
33.51	50.75	"
32.77	52.12	"
31.64	53.77	"
30.63	55.58	"
29.60	57.18	"
28.95	58.32	"
28.20	59.60	"
27.55	60.34	$KI_3 \cdot 2H_2O + I$
27.09	58.76	I
27.19	56.79	"
26.63	52.99	"
25.36	42.28	"
21.84	29.56	"
18.40	21.12	"
13.22	13.39	"
Results at 25°		
60.15	0.0	KI
56.91	6.59	"
46.56	26.76	"
36.95	46.94	"
32.54	57.05	"
30.84	60.89	"
30.12	61.97	"
30.08	62.28	$KI + KI_3 \cdot H_2O$
30.03	63.02	$KI_3 \cdot H_2O$
29.12	63.80	"
28.90	64.18	"
28.50	64.51	"
27.33	66.42	"
27.24	66.51	$KI_3 \cdot H_2O + KI_7 \cdot H_2O$
26.98	66.57	$KI_7 \cdot H_2O$
26.67	66.83	"
26.22	67.31	"
25.96	67.53	"
25.80	67.71	"
25.75	67.80	"
25.64	67.76	$KI_7 \cdot H_2O + I$
25.57	67.68	I
25.28	67.26	"
25.01	65.94	"
24.89	57.03	"
19.13	25.37	"
10.87	10.49	"
2.09	1.62	"

The authors also studied the system from the eutectic to about 60°, and present tables and diagrams of the polythermal data. It was found that $KI_3 \cdot 2H_2O$ can exist in two modifications, but no other compounds were formed.

INVARIANT POINTS IN THE POLYTHERMAL SYSTEM $KI + I + H_2O$

t°	Gms. per 100 gms. Sat. Sol. I	KI	Solid Phase
-22.7	0.0	52.2	Ice + KI
0	Trace	0.0	Ice + I
80.8	85.3	14.7	KI + I
-23.7	44.1	19.4	$Ice + \alpha\text{-}KI_3 \cdot 2H_2O + KI$
~ 1.0	48.7	35.0	$KI + \alpha\text{-}KI_3 \cdot 2H_2O + \beta\text{-}KI_3 \cdot 2H_2O$
12.3	54.9	32.8	$KI_3 \cdot H_2O + KI + \beta\text{-}KI_3 \cdot 2H_2O$
30.0	67.4	26.5	$KI_3 \cdot H_2O + KI + KI_7 \cdot H_2O$
38.0	70.9	24.4	$KI_7 \cdot H_2O + KI + I$
3.0	60.3	28.5	$\beta\text{-}KI_3 \cdot 2H_2O + KI_3 \cdot H_2O + KI_7 \cdot H_2O$
~ 1.0	59.8	28.4	$\alpha\text{-}KI_3 \cdot 2H_2O + \beta\text{-}KI_3 \cdot 2H_2O + KI_7 \cdot H_2O$
-4.9	59.0	28.2	$\alpha\text{-}KI_3 \cdot 2H_2O + KI_7 \cdot H_2O + I$
-19.6	51.5	28.5	$Ice + \alpha\text{-}KI_3 \cdot 2H_2O + I$

The distribution of iodide ions at 25° between solid and liquid phases in the systems KBr - KI - H_2O and KCl - KI - H_2O in solutions containing small amounts of iodide was studied by Cirkov and Schnee, 1939a.

SOLUBILITY OF POTASSIUM IODIDE IN LIQUID SULFUR DIOXIDE AT 25°

(Shatenstein and Viktorov, 1937)

100 gms. of a saturated solution of KI in SO_2 at 25° contain 0.75 gms. KI.

SOLUBILITY OF POTASSIUM IODIDE IN ACETONE

(Livingston and Halverson, 1946)

The density of the acetone was 0.786 at 25°.

t°	Gms. KI per 100 gms. Sat. Sol.	t°	Gms. KI per 100 gms. Sat. Sol.
54.50	0.84	-56.4	9.2
48.75	0.89	-57.0	9.79
26.54	1.30	-57.6	9.79
25.00	1.330	-58.5	9.0
4.62	2.02	-64.4	6.84
-26.3	3.87	-78.5	4.15
-44.8	6.08		

SOLUBILITY OF POTASSIUM IODIDE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent	Gms. KI per 100 gms. Solvent
Ethylenediamine	74.9
Monoethanolamine	42.3
Ethylene Glycol	49.9

SOLUBILITY OF POTASSIUM IODIDE IN ORGANIC SOLVENTS AT 25°

(Semenchenko and Shakparonov, 1948)

Solvent	Moles KI per 100 moles Sat. Sol.	Solvent	Moles KI per 100 moles Sat. Sol.	Solvent	Moles KI per 100 moles Sat. Sol.
C_6H_5CHO	0.002	CH_3OH	0.036	Glycol	0.162
$(CH_3)_2CO$	.004	CH_3NO_2	.001	Hydrazine	.250*
C_2H_5OH	.005	CH_3CN	.005	H_2O	.138
C_6H_5CN	.003	Furfural	.027		

* at 18°

5% Potassium Iodide by weight dissolve in acetonitrile at 25°. (Pleskov, 1948)

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE - SODIUM IODIDE - METHANOL

(Sarkisov, Sakarova, and Antropov, 1949)

The solid phase was not solvated.

t°	Saturated Solution Wt. % NaI	Saturated Solution Wt. % KI	Wt. % KI in Solid Phase	t°	Saturated Solution Wt. % NaI	Saturated Solution Wt. % KI	Wt. % KI in Solid Phase
10	0.0	12.0	100.0	30	0.0	14.0	100.0
	17.7	7.2	58.05		25.0	8.6	43.2
	24.5	8.0	18.34		33.0	9.0	20.1
	28.2	5.7	0.0		34.3	9.7	2.2
	40.0	0.0	0.0		37.7	8.3	0.0
					44.8	0.0	0.0
20	0.0	13.1	100.0	40	0.0	15.3	100.0
	26.4	7.1	46.0		25.5	8.1	54.3
	33.4	7.4	20.7		32.9	9.2	26.3
	38.2	7.0	7.3		35.7	10.4	0.0
	41.9	0.0	0.0		37.8	9.1	0.0
					46.6	0.0	0.0

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODIDE - SODIUM IODIDE - FURFURAL I

(Sarkisov, Sakarova, and Antropov, 1947)

The solid phase is a mixture of KI + NaI in each case.

Results at 20°		Results at 30°		Results at 40°	
Gms. NaI per 100 gms. Sat. Sol.	Gms. KI per 100 gms. Sat. Sol.	Gms. NaI per 100 gms. Sat. Sol.	Gms. KI per 100 gms. Sat. Sol.	Gms. NaI per 100 gms. Sat. Sol.	Gms. KI per 100 gms. Sat. Sol.
0.0	6.0	0.0	4.5	0.0	3.1
6.5	3.4	1.9	5.3	4.8	1.8
7.4	2.9	5.0	4.6	5.0	1.8
11.2	2.8	9.1	2.9	5.3	1.7
12.2	2.7	16.2	1.6	13.0	1.6
20.5	0.0	24.0	0.0	27.2	0.0

Melting points in the system KI + MgI_2 are given by Klemm, Beyersdorfer, and Oryschkewitsch, 1948.

The reactions between the solids below their melting points were studied by Link and Wood, 1940 for the following pairs: KI + RbF, KI + CsF.

IO POTASSIUM IODATE KIO_3

EQUILIBRIUM IN THE SYSTEM POTASSIUM IODATE - IODIC ACID - WATER
(Smith, 1947)

The results appear to confirm the work of Meerberg (Vol. I, p. 824), but Ricci and Amron (1951) have recalculated Smith's data and find that the compound $KIO_3 \cdot 2HIO_3$ may actually be $KIO_3 \cdot I_2O_5$.

Saturated Solution Wt. %		Solid Phase
HIO_3	KIO_3	
Results at 0°		
0.0	4.51	KIO_3
0.35	4.47	KIO_3 + 1:1
1.30	1.68	1:1
5.76	0.13	1:1 + 1:2
73.69	0.39	1:2 + HIO_3
73.56	0.0	HIO_3
Results at 25°		
0.0	8.39	KIO_3
0.61	8.46	KIO_3 + 1:1
0.77	4.90	1:1
7.68	0.61	1:1 + 1:2
75.51	0.42	1:2 + HIO_3
75.56	0.0	HIO_3
Results at 50°		
0.0	13.21	KIO_3
1.34	13.58	KIO_3 + 1:1
3.74	4.64	1:1
11.02	1.85	1:1 + 1:2
78.72	1.17	1:2 + HIO_3
78.78	0.0	HIO_3

SOLUBILITY OF POTASSIUM IODATE IN LIQUID AMMONIA SOLUTIONS AT 25°
(Anborn and Hunt, 1941)

Moles Added Salt per		Moles KIO_3 x 10^5 per
Liter of Sat. Sol.	1000 gms. NH_3	1000 gms. NH_3
0.0	0.0	3.044
	KCl Added	
0.001907	0.003162	0.7439
.002658	.004407	.8428
.007624[s]	.01264	1.4238
	KBr Added	
0.002492	0.004131	0.7392
.004468	.007407	.8180
.005864	.009721	.8595
.007025	.01165	.8876
.01170	.01940	.9062
.02591	.04295	1.0684
.04867	.08070	1.1350
.07078	.1173	1.1678
.1195	.1981	1.2090
.1549	.2568	1.2330

Moles Added Salt per		Moles KIO_3 x 10^5 per
Liter of Sat. Sol.	1000 gms. NH_3	1000 gms. NH_3
	NH_4Cl Added	
0.0009398	0.001558	5.7782
.002220	.003670	7.1681
.004161	.006898	8.7650
.007543	.01251	10.662
.01035	.01715	11.820
.01822	.03020	14.025
.02243	.03718	14.920
.03251	.05389	16.580
.04568	.07572	18.045
.07695	.1275	20.688
.1060	.1758	22.189
.1463	.2424	23.975
.1635	.2710	24.590
.2004	.3320	25.745
.2657	.4402	27.480
.3800	.6299	30.018
.4330	.7180	30.980
.5728	.9528	33.160

s = saturated with KCl

Moles Added Salt per Liter of Sat. Sol.	Moles Added Salt per 1000 gms. NH_3	Moles KIO_3 x 10^5 per 1000 gms. NH_3	Moles Added Salt per Liter of Sat. Sol.	Moles Added Salt per 1000 gms. NH_3	Moles KIO_3 x 10^5 per 1000 gms. NH_3
	KI Added			NaCl Added	
0.001709	0.002834	0.2438	0.0003685	0.0006109	4.495
.004258	.007058	.4893	.001655	.002744	5.489
.005154	.008534	.5165	.003543	.005874	5.831
.01098	.01819	.5682	.007738	.01283	6.188
.01801	.02985	.6188	.03063	.05078	7.098
.03735	.06191	.7211	.04352	.07214	7.377
.03774	.06254	.7370	.09376	.1554	8.024
.05310	.08801	.7849	.1154	.1913	8.233
.08446	.1400	.8868	.1554	.2575	8.611
.1031	.1709	.9362	.2101	.3482	8.913
.1234	.2046	.9886	.2746	.4551	9.145
.2224	.3693	1.1530			
.3018	.5021	1.2140			

SOLUBILITY OF POTASSIUM IODATE IN DIOXANE - WATER MIXTURES AT 25°

(Ricci and Nesse, 1942)

Wt. % Dioxane in Solvent	Gms. KIO_3 per 100 gms. Sat. Sol.	Moles KIO_3 per liter Sat. Sol.	Wt. % Dioxane in Solvent	Gms. KIO_3 per 100 gms. Sat. Sol.	Moles KIO_3 per liter Sat. Sol.
0	8.472	0.4238	60	0.1350	0.00653
10	5.300	.2598	70	.0384	.00186
20	3.172	.1531	80	.0060	.00029
30	1.815	.08770	90	.0012	.000059
40	0.8855	.04273	100	.0000	.00000
50	.4712	.02277			

Less than 0.005 gms. of KIO_3 dissolve in 100 gms. of ethylenediamine at 25°. (Isbin and Kobe, 1945)

POTASSIUM PERIODATE KIO_4 IO

SOLUBILITY IN UREA AND DIOXANE SOLUTIONS

(Pederson, 1941)

17.85°		18.00°	
Moles Urea per 1000 ml. Solvent	Moles KIO_4 per 1000 ml. Sat. Sol.	Moles Urea per 1000 ml. Solvent	Moles KIO_4 per 1000 ml. Sat. Sol.
0.0	0.01605	0.0	0.01618
.250	.01642	.200	.01593
.500	.01679	.400	.01573
.750	.01715	.600	.01555
1.000	.01751	.800	.01540
		1.000	.01525

MnO POTASSIUM PERMANGANATE $KMnO_4$

SOLUBILITY OF POTASSIUM PERMANGANATE IN DEUTERIUM OXIDE SOLUTIONS

(Noonan, 1948)

t°	Mole % D_2O	Moles $KMnO_4$ per 100 moles $H_2O + D_2O$	t°	Mole % D_2O	Moles $KMnO_4$ per 100 moles $H_2O + D_2O$
5	0.0	0.4002	25	0.0	0.8696
	91.59	.302		90.86	.700
	100.0	.293		100.0	.673
15	0	.600	35	0	1.1224
	90.86	.471		90.86	1.1010
	100.0	.458		100.0	0.989

NO POTASSIUM NITRATE KNO_3

SOLUBILITY OF POTASSIUM NITRATE IN AMMONIA SOLUTIONS

(Alexandrov, 1941)

Gms. NH_3 per 100 gms. H_2O in Sat. Sol.	Gms. KNO_3 per 100 gms. H_2O in Sat. Sol.					
	-10°	0°	10°	20°	30°	40°
0	-	13.3	22.1	31.7	45.2	64.0
10	5.4	8.9	13.6	20.0	29.7	42.7
20	4.1	7.2	11.0	15.5	23.2	33.7
25	3.8	6.6	10.1	14.4	21.1	30.6
30	3.6	6.4	9.6	13.8	19.5	28.0
40	3.3	6.1	9.1	13.1	18.0	25.0

The system $KNO_3 - NaNO_3 - H_2O$ was investigated from the eutectic to the melting points by Ravich and Ginsberg, 1947. Above 150° I-KNO_3 + Na NO_3 form continuous solid solutions. Below 105° II-KNO_3 and Na NO_3 are stable as pure phases. The eutectic temperature is -19.0°, and the solution contains 5.58% KNO_3 and 36.88% $NaNO_3$.

EQUILIBRIUM IN THE SYSTEM POTASSIUM NITRATE - SODIUM NITRATE - WATER

(Benrath, 1943)

t°	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. $NaNO_3$ per 100 gms. Sat. Sol.	Solid Phase
125	56.5	30.5	$NaNO_3 + \beta KNO_3 + \alpha KNO_3$
150	55.5	34.5	$NaNO_3 + \beta KNO_3$
175	54	39.75	"
200	54	43.5	"
225*	54.6	45.4	

*Madgin and Briscoe, J. Chem. Soc. 123, 2915, (1923)

EQUILIBRIUM IN THE SYSTEM POTASSIUM NITRATE - POTASSIUM CHLORIDE - WATER

(Benrath, 1948)

t°	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. KCl_3 per 100 gms. Sat. Sol.	Solid Phase
125	68.2	8.8	$KCl + \alpha\text{-}KNO_3 + \beta\text{-}KNO_3$
150	73.5	8.5	$KCl + \beta\text{-}KNO_3$
175	77.3	8.2	"
200	81.3	8.2	"
225	83.7	8.3	"
250	85.8	8.2	"
331.5*	94.4	5.6	"

*Ferman and Saunders J. Chem. Soc. 123, 841, (1923)

EQUILIBRIUM IN THE SYSTEM POTASSIUM NITRATE - POTASSIUM SULFATE - WATER AT 310°

NO

(Benrath, 1948)

At about 310°, the solubility curve of potassium sulfate in water exhibits a sharp change in slope, and the salt becomes less soluble upon increasing the temperature. Although the nature of the change has not been determined crystallographically, the break is sharp enough to be followed in the ternary system with added potassium nitrate. This maximum of the solubility of potassium sulfate was found to remain at 310° as the potassium nitrate is added.

Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. K_2SO_4 per 100 gms. Sat. Sol	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. K_2SO_4 per 100 gms. Sat. Sol.
2.9	25.7	40.0	10.0
6.1	24.4	63.0	7.0
17.0	17.0	92.2	4.85

EQUILIBRIUM IN THE SYSTEM POTASSIUM NITRATE - POTASSIUM DIHYDROGEN PHOSPHATE - WATER

(Bergman and Botchkareff, 1938)

The results are also given per 100 moles of dissolved salts.

Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase
Results at 0°			Results at 10°		
11	0.0	KNO_3	16.6	0.0	KNO_3
9.9	3.6	"	15.3	3.4	"
9.3	6.0	"	13.2	8.6	"
8.5	9.0	"	12.8	10.2	$KNO_3 + KH_2PO_4$
8.4	9.8	$KNO_3 + KH_2PO_4$	8.9	11.2	KH_2PO_4
4.2	10.5	KH_2PO_4	5.0	12.6	"
0.0	11.8	"	0.0	15.	"

Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase
Results at 20°			Results at 30°		
23.0	0.0	KNO_3	31.0	0.0	KNO_3
21.6	3.0	"	28.8	2.8	"
19.0	8.0	"	25.6	7.4	"
17.9	10.4	$KNO_3 + KH_2PO_4$	23.2	10.9	$KNO_3 + KH_2PO_4$
16.1	10.8	KH_2PO_4	15.8	12.2	KH_2PO_4
8.7	13.2	"	8.4	15.8	"
5.8	14.6	"	6.8	17.	"
0.0	18.2	"	0.0	21.4	"

The eutectic occurs at -3.8°; 7% KNO_3, 9.3% KH_2PO_4.

N.O

THE SYSTEM $KNO_3 + NH_4H_2PO_4 \rightleftharpoons NH_4NO_3 + KH_2PO_4$

(Bochkarev and Bergman, 1940)

The system was studied from -10° to the melting points of the salts, and the data are presented in weight and molar bases, and in many diagrams. Continuous solid solutions of $KH_2PO_4 + NH_4H_2PO_4$ occupy the largest area of the diagram, and they become discontinuous as the KNO_3 field is approached. At higher temperatures the solid solutions become continuous at all concentrations. The isothermally invariant points are given below:

t°	Moles per 100 moles of Dissolved Salts					Solid Phase
	KH_2PO_4	$NH_4H_2PO_4$	NH_4NO_3	KNO_3	H_2O	
-10	-	16.0	63.0	21.0	1240	$KNO_3 + NH_4H_2PO_4 +$ Ice
-10	-	12.5	69.5	18.0	1000	$KNO_3 + NH_4H_2PO_4 + \alpha KNO_3 \cdot \beta NH_4NO_3$
-10	-	2.5	88.5	9.0	510	$NH_4NO_3 + NH_4H_2PO_4 + \alpha KNO_3 \cdot \beta NH_4NO_3$
-5	55.0	-	40.0	5.0	2500	Ice + KNO_3 + KH_2PO_4
-5	-	54.5	4.5	41.0	1800	$KNO_3 + KH_2PO_4 + NH_4H_2PO_4$
-5	-	17.0	62.5	20.5	1200	$KNO_3 + NH_4H_2PO_4 + \alpha KNO_3 \cdot \beta NH_4NO_3$
-5	-	2.5	88.0	9.5	440	$NH_4NO_3 + NH_4H_2PO_4 + \alpha KNO_3 \cdot \beta NH_4NO_3$
0	-	2.0	89.0	9.0	480	$NH_4NO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
0	55.0	-	45.0	-	1860	$K(NH_4)H_2PO_4 + NH_4(K)H_2PO_4 + KNO_3$
0	-	16.5	59.5	24.0	1000	$KNO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
10	45.0	-	36.5	18.5	1500	$KNO_3 + K(NH_4)H_2PO_4 + NH_4(K)H_2PO_4$
10	-	1.8	91.2	7.0	300	$NH_4NO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
10	-	16.0	56.5	27.5	1850	$KNO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
20	-	32.0	-	68.0	1150	$KNO_3 + K(NH_4)H_2PO_4$
20	-	16.0	49.0	35.0	760	$KNO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
20	-	1.5	93.0	5.0	270	$NH_4NO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
30	-	16.0	44.0	40.0	680	$KNO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$
30	-	1.4	94.6	4.0	220	$NH_4NO_3 + \alpha KNO_3 \cdot \beta NH_4NO_3 + NH_4(K)H_2PO_4$

Additional data for the system $KNO_3 + NH_4NO_3 + H_2O$ at 25° are given by Bahl and Singh, 1940, and by Chand and Jain, 1945. Neither author found the solid solutions reported by previous workers (Vol. I, p. 842, 843), and their data probably do not represent equilibrium conditions.

EQUILIBRIUM IN THE SYSTEM POTASSIUM NITRATE - AMMONIUM DIHYDROGEN PHOSPHATE - WATER

(Bergman and Botchkareff, 1938)

Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.	Solid Phase
Results at 0°		
0.0	18.4	$NH_4H_2PO_4$
5.0	17.2	"
8.4	15.8	"
11.6	13.7	$NH_4H_2PO_4 + KNO_3$
11.5	11.6	"
11.4	5.4	"
11.2	0.0	"
Results at 20°		
0.0	25.5	$NH_4H_2PO_4$
4.5	24.0	"
7.7	22.5	"
11.2	20.0	"
14.8	17.0	"
17.0	15.2	"
21.8	11.8	$NH_4H_2PO_4 + KNO_3$
21.7	10.2	KNO_3
22.4	4.7	"
23.0	0.0	"
Results at 10°		
0.0	21.3	$NH_4H_2PO_4$
4.8	20.4	"
8.0	19.0	"
11.7	16.4	"
13.4	15.3	"
16.1	13.0	$NH_4H_2PO_4 + KNO_3$
16.0	11.0	KNO_3
16.2	5.1	"
16.6	0.0	"
Results at 30°		
0.0	30.2	$NH_4H_2PO_4$
4.4	27.5	"
7.3	26.0	"
10.6	23.9	"
16.2	19.2	"
21.1	15.4	"
27.0	10.6	$NH_4H_2PO_4 + KNO_3$
27.2	9.8	KNO_3
29.0	4.3	"
31.0	0.0	"

ADDITIONAL DATA IN THE SYSTEM POTASSIUM NITRATE - AMMONIUM DIHYDROGEN PHOSPHATE - WATER

(Bergman, Botchkareff, 1938)

t°	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.	Solid Phase
-4.4	0.0	17.4	$NH_4H_2PO_4$ + Ice
-5.3	5.0	15.4	"
-6.0	8.6	13.8	"
0.4	12.0	13.8	$NH_4H_2PO_4 + KNO_3$
12.6	17.4	12.7	"
20.7	22.0	11.7	"
32.7	28.6	10.4	"
-5.7	9.5	11.8	KNO_3 + Ice
-5.4	9.5	10.8	"
-4.2	9.7	5.4	"
-2.5	9.8	0.0	"
-6.3	9.6	13.2	$NH_4H_2PO_4 + KNO_3$ + Ice

EQUILIBRIUM IN THE SYSTEM POTASSIUM NITRATE - MAGNESIUM CHLORIDE - WATER

(Bergman and Nagorny 1938)

SOLUBILITY OF MAGNESIUM CHLORIDE IN POTASSIUM NITRATE SOLUTIONS AND VICE VERSA

Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 gms. Sat. Sol.	Solid Phase
	Results at 30°	
0.0	31.3	KNO_3
7.8	20.6	"
17.0	14.0	"
21.4	11.7	"
23.2	10.8	"
24.0	10.4	KNO_3 + KCl
27.6	5.2	KCl
28.4	3.8	"
33.5	0.4	KCl + $MgCl_2 \cdot 6H_2O$
	Results at 10°	
0.0	17.7	KNO_3
8.8	12.0	"
18.0	8.0	"
19.2	7.8	"
21.4	6.8	"
22.4	6.3	"
25	6.2	KNO_3 + KCl
26.6	3.6	KCl
28.6	1.6	"
33.9	0.2	KCl + $MgCl_2 \cdot 6H_2O$
	Results at -10°	
11.6	0.0	Ice
11.2	1.6	"
10.6	3.3	"
9.6	5.8	Ice + KNO_3
15.4	4.8	KNO_3
18.8	4.3	"
23.2	3.8	"
25.0	3.5	"
25.4	3.3	KNO_3 + KCl
29.0	0.6	KCl + $MgCl_2 \cdot 8H_2O$
32.6	0.0	$MgCl_2 \cdot 8H_2O$
	Results at -30°	
19.4	0.0	Ice
19.8	2	Ice + KNO_3
22.4	2	KNO_3 + $MgCl \cdot 12H_2O$
22	1.4	$MgCl_2 \cdot 12H_2O$
22.0	0.0	"

Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 gms. Sat. Sol.	Solid Phase
	Results at 20°	
0.0	24.2	KNO_3
8.2	15.8	"
17.6	10.4	"
21.9	8.39	"
24.0	8.3	"
24.5	8.2	KNO_3 + KCl
24.8	7.6	KCL
27.6	3.8	"
28.3	3.0	"
33.8	0.3	KCl + $MgCl_2 \cdot 6H_2O$
	Results at 0°	
0.0	11.5	KNO_3
9	8.8	"
18.4	6.0	"
22.9	5.2	"
24.8	4.6	"
25.4	4.4	KNO_3 + KCl
26.0	3.6	KCl
28.7	1.0	"
34.0	1.05	"
	Results at -20°	
16.8	0.0	Ice
16.2	2.2	"
15.6	3.4	Ice + KNO_3
19.9	3	KNO_3
21.4	2.9	"
23.5	2.7	"
25.8	2.4	KNO_3 + KCl
26.0	2.35	KCl
28.2	0.6	KCl + $MgCl_2 \cdot 12H_2O$
26.8	0.0	$MgCl_2 \cdot 12H_2O$

The Invariant points are:

(-33.5°):		
20.2	2.1	Ice + KNO_3 + $MgCl_2 \cdot 12H_2O$
(-23.2°):		
25.8	2	KNO_3 + KCl + $MgCl_2 \cdot 12H_2O$

71.4 gms. KNO_3 dissolve in 100 gms. of anhydrous HNO_3 (no temperature given) (Jander and Wendt, 1948).

SOLUBILITY OF POTASSIUM NITRATE IN LIQUID AMMONIA

(Schattenstein and Viktorov, 1936)

The authors review the methods of making determinations in liquid ammonia and compared the results of each.

t°	Gms. KNO_3 per 100 gms. Sat. Sol.	Gms. KNO_3 per 100 cc Sat. Sol.	Density
0.12	9.58	6.65	0.695
25	10.56	7.10	0.672
25*	10.55	7.09	0.672

*Schattenstein and Monossohn, 1932.

SOLUBILITY OF POTASSIUM NITRATE IN ETHANOL-WATER MIXTURES NO

(Thompson and Vener, 1948)

Results are in gms. KNO_3 per 100 gms. Sat. Sol. Densities are gms/ml in vacuo.

Solvent Wt. % Alcohol Density at 35°	Temperature 25°	30°	35°	40°	45°	50°
0.0	27.24	31.49	35.40	39.02	42.64	46.11
	1.1864	1.2167	1.2458	1.2740	1.3059	1.3358
9.82	19.16	22.40	25.73	29.25	33.03	37.18
0.97714	1.1049	1.1285	1.1524	1.1771	1.2026	1.2302
19.90	13.18	15.80	18.54	21.54	24.80	28.43
0.96150	1.0469	1.0607	1.0763	1.0938	1.1136	1.1367
29.89	9.02	10.85	12.86	15.18	17.87	21.00
0.94424	1.0018	1.0097	1.0195	1.0324	1.0473	1.0636
49.90	4.20	5.11	6.07	7.11	8.34	9.80
0.90191	0.9326	0.9334	0.9347	0.9367	0.9398	0.9443
69.83	1.353	1.633	1.925	2.236	2.953	3.001
0.85510	0.8708	0.8670	0.8639	0.8613	0.8594	0.8570
92.63	0.096	0.111	0.128	0.146	0.168	0.195
0.79769	0.8058	0.8017	0.7977	0.7933	0.7890	0.7851

	55°	60°	65°	70°	75°
0.0	49.28	52.33	55.20	57.87	60.50
	1.3640	1.3905	1.4137	1.4390	1.4629
9.82	41.05	44.55	47.88	51.14	54.38
0.97714	1.2596	1.2892	1.3180	1.3461	1.3738
19.90	32.10	35.80	39.52	43.16	46.78
0.96150	1.1628	1.1910	1.2190	1.2456	1.2735
29.89	24.09	27.39	30.77	34.45	38.38
0.94424	1.0802	1.0987	1.1199	1.1433	1.1685
49.90	11.58	13.50	15.60	17.94	20.60
0.90191	0.9508	0.9592	0.9692	0.9805	0.9930
69.83	3.457	3.993	4.575	5.207	5.945
0.85510	0.8554	0.8542	0.8531	0.8524	0.8520
92.63	0.236	0.284	0.349	0.422	0.501
0.79769	0.7814	0.7779	0.7742	0.7705	0.7668

SOLUBILITY OF POTASSIUM NITRATE IN ISOPROPYL ALCOHOL - WATER MIXTURES

(Thompson and Molstad, 1945)

Results are in gms. KNO_3 per 100 gms. Sat. Sol. Densities are gms/ml in vacuo.

Solvent Wt. % Isopropyl Alcohol / Density at 35°	Temperature 25°	30°	35°	40°	45°	50°
0.0	27.24	31.49	35.40	39.02	42.64	46.11
	1.1864	1.2167	1.2458	1.2740	1.3059	1.3358
5.07	22.86	26.62	30.38	34.13	37.85	41.50
0.98510	1.1416	1.1681	1.1951	1.2219	1.2503	1.2792
7.01	21.16	24.91	28.64	32.34	36.03	39.72
0.98186	1.1255	1.1506	1.1764	1.2034	1.2304	1.2751
9.96	18.96	22.44	25.98	29.53	33.32	37.13
0.97726	1.1046	1.1256	1.1478	1.1720	1.1998	1.2294
19.89	13.14	16.06	19.11	22.42	26.15	
0.96112	1.0448	1.0610	1.0790	1.0988	1.1218	
29.88	9.53	11.85	14.27	17.00	20.25	
0.94087	1.0021	1.0131	1.0242	1.0380	1.0550	
49.94	4.44	5.78	7.09	8.33	9.50	
0.89417	0.9277	0.9296	0.9318	0.9348	0.9380	
69.84	1.495	1.785	2.099	2.456	2.876	3.346
0.84647	0.8626	0.8597	0.8570	0.8545	0.8524	0.8505
79.86	0.488	0.603	0.720	0.837	0.956	1.075
0.82248	0.8341	0.8297	0.8256	0.8216	0.8177	0.8140
87.60	0.126	0.151	0.178	0.206	0.237	0.271
0.80358	0.8136	0.8088	0.8041	0.8000	0.7948	0.7896

	55°	60°	65°	70°	75°
0.0	49.28	52.33	55.20	57.87	60.50
	1.3640	1.3905	1.4137	1.4390	1.4629
5.07	45.03	48.39	51.56	54.56	57.52
0.98510	1.3090	1.3381	1.3665	1.3930	1.4186
7.01	43.36	46.84	50.38		
0.98186	1.2850	1.3166	1.3502		
9.96	41.14				
0.97726	1.2610				
69.84	3.847				
0.84647	0.8486				
79.86	1.213	1.425	1.675	1.841	
0.82248	0.8103	0.8068	0.8032	0.7966	
87.60	0.312	0.365	0.411	0.443	0.477
0.80358	0.7851	0.7806	0.7766	0.7727	0.7689

TWO - PHASE DATA [KNO_3 - ISOPROPANOL - WATER]

t°	Upper Layer			Lower Layer			
	Wt. % KNO_3 In Sat. Sol.	Density Sat. Sol.	Wt. % Alcohol in Solvent	Wt. % KNO_3 in Sat. Sol.	Density Sat. Sol.	Wt. % Alcohol in Solvent	
50	7.52	0.8892	5.92	31.55	1.1852	17.5	
55	4.197	.8531	68.7	40.22	1.2510	11.2	
60	3.185	.8293	73.1	45.82	1.3043	8.4	
65	2.491	.8150	76.4	50.25	1.3486	6.9	
70	2.000	.8036	78.9	54.11	1.3862	5.8	
75	1.75	.7932	80.8	57.43	1.4125	5.1	NO

Rothchild, Templeton, and Hall (1948) studied the distribution of KNO_3 between methyl n-hexyl ketone and water at room temperature. 14.5 gms. KNO_3 were dissolved in 100 gms. of saturated aqueous phase and $(0.0085)^x$ (14.5) in the ketone phase.

0.37 gms. KNO_3 dissolve in 100 gms. of ethylenediamine at 25°. (Isbin and Kobe, 1945).

Melting points have been determined for the following systems:

$KNO_3 + NaNO_3$	(Jänecke, 1942, 1949)
$KNO_3 + NH_4NO_3$	(Jänecke, 1949)
$KNO_3 + NH_4NO_3 + NaNO_3$	(Campbell and Campbell, 1947)
$KNO_3 + Mg(NO_3)_2$	(Jänecke, 1942)
$KNO_3 + Mg(NO_3)_2 + NaNO_3$	" "
$KNO_3 + NaNO_3 + Tl\ NO_3$	(Leman, 1940)
$2KNO_3 + Tl_2SO_4 \rightleftharpoons 2TlNO_3 + K_2SO_4$	" "
$KNO_3 + K_2SO_4 + Tl_2Cl_2$	(Rostovskii, 1940)
$2KNO_3 + Na_2SO_4 \rightleftharpoons K_2SO_4 + 2NaNO_3$	(Bergman and Wachsberg, 1937)
$KNO_3 + Ca(NO_3)_2$	(Kitrov, 1947)
$KNO_3 + NaNO_2 \rightleftharpoons KNO_2 + NaNO_3$	(Alexander and Hindin, 1947)
$KNO_3 + N_2H_2 \cdot HNO_3$	(Barlot and Marsaule, 1948)

The temperatures at which KNO_3 + TlBr are completely immiscible, alone and with added salts, were determined by Semenchenko and Shashkina, 1945.

Solid solutions in the system $KNO_3 + NH_4NO_3$ were studied by X-rays and by precipitation from water solutions by Whetstone, 1948.

The specific volumes and heat capacities of solutions of $KNO_3 + NH_4NO_3$ are given by Rutskov, 1948.

The system KNO_3 + $PbNO_3$ + H_2O was studied by Nayar and Pande, 1948 by means of the density, viscosity, rheochor, specific conductivity, surface tension, parachor, freezing point depression, magnetic susceptability, transport number and electromotive force.

O POTASSIUM OXIDE K_2O

The system K_2O + ZnO + SiO_2 was determined by Ingerson, Morey, and Tuttle, 1948.

Data for the system K_2O + PbO + SiO_2 is given by McMurdie, 1941.

OH POTASSIUM HYDROXIDE KOH

EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE - ETHYL ALCOHOL - WATER
(Peyronel, 1949a)

t°	Upper Layer		Lower Layer	
	Wt. % C_2H_5OH	Wt. % KCH	Wt. % C_2H_5OH	Wt. % KOH
17	56.40	30.10	0.64	52.80
	55.15	27.55	0.93	48.60
	54.52	26.35	1.34	45.45
	48.95	23.93	2.77	39.82
	29.50	27.08	10.13	32.68
30	58.70	31.73	0.48	56.66
	56.52	26.93	1.20	47.40
	48.17	22.13	3.87	47.83
	46.10	22.08	5.13	35.63
	36.04	23.63	9.84	33.62
	25.60	26.73	(One layer only)	
60	60.50	32.72	-	61.00
	59.24	24.90	1.36	48.70
	54.10	19.18	4.47	36.63
	43.45	19.83	8.88	31.80
	38.50	21.00	11.50	31.60
90	59.70	35.08	-	63.55
	60.40	24.95	0.90	47.60
	53.95	19.33	6.57	34.04
	47.70	18.50	9.78	31.20

EQUILIBRIUM IN THE SYSTEM POTASSIUM HYDROXIDE - HYDRAZINE - WATER AT 50°

(Penneman and Audrieth, 1949)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
N_2H_4	KOH		N_2H_4	KOH	
91.9	1.8	$KOH \cdot H_2O$	38.2	32.2	$KOH \cdot H_2O$
68.8	12.8	"	19.1	45.6	"
59.1	19.1	"	13.0	50.2	"
42.7	29.3		4.8	56.0	"

POTASSIUM PHOSPHATES

PO

EQUILIBRIUM IN THE SYSTEM $K_2O - P_2O_5 - H_2O$ AT 0°, 25°, 50°

(Ravich, 1938a; Berg, 1938, 1938a)

Six stable phases were found at each temperature, and the results agree well with each other. The data are also tabulated in mole %.

Gms. K_2O per 100 gms. Sat. Sol.	Gms. P_2O_5 per 100 gms. Sat. Sol.	Solid Phase	Gms. K_2O per 100 gms. Sat. Sol.	Gms. P_2O_5 per 100 gms. Sat. Sol.	Solid Phase
Results at 0°					
0.0	57.17	$2H_3PO_4 \cdot H_2O$	10.54	43.49	$KH_5(PO_4)_2 + KH_2PO_4$
1.64	58.01	"	*10.92	45.04	KH_2PO_4
3.78	58.84	"	10.22	41.76	"
4.89	59.57	"	8.93	35.92	"
5.06	59.50	$2H_3PO_4 \cdot H_2O + KH_5(PO_4)_2$	8.17	32.30	"
*5.75	62.01	$KH_5(PO_4)_2$	6.85	22.48	"
*5.51	61.60	"	5.75	15.75	"
*5.27	61.11	"	4.89	9.75	"
4.93	58.92	"	4.41	6.66	"
4.38	56.12	"	6.35	8.05	"
4.33	55.87	"	8.50	9.80	"
5.30	50.19	"	15.18	15.10	"
6.05	47.93	"	16.20	15.98	"
8.15	45.02	"	21.18	19.86	"
10.37	43.62	"	22.49	20.45	"

*Metastable

Gms. K_2O per 100 gms. Sat. Sol.	Gms. P_2O_5 per 100 gms. Sat. Sol.	Solid Phase
Results at 0° (Con.)		
27.10	24.00	KH_2PO_4
27.63	23.97	$KH_2PO_4 + K_2HPO_4 \cdot 6H_2O$
*29.24	25.23	?
*30.54	25.69	?
*31.50	25.58	$K_2HPO_4 \cdot 3H_2O$
*31.03	24.05	"
*30.86	23.26	"
*32.70	22.23	"
34.38	21.90	$K_2HPO_4 \cdot 3H_2O +$
34.49	22.06	$K_3PO_4 \cdot 7H_2O$
27.05	23.01	$K_2HPO_4 \cdot 5H_2O$
25.94	20.80	"
24.91	18.82	"
26.92	18.60	"
29.35	18.72	"
31.29	19.75	"
32.62	19.80	$K_2HPO_4 \cdot 6H_2O + K_3PO_4 \cdot 7H_2O$
32.83	19.80	$K_3PO_4 \cdot 7H_2O$
32.28	19.53	"
31.26	17.55	"
30.20	15.81	"
29.46	14.80	"
29.60	13.59	"
29.28	13.41	"
29.18	11.98	"
Results at 25°		
*47.25	0.0	$KOH \cdot H_2O$
45.51	0.0	$KOH \cdot 2H_2O$
*47.49	1.37	$KOH \cdot H_2O + K_3PO_4 \cdot 3H_2O$
*46.18	1.73	$K_3PO_4 \cdot 3H_2O$
*45.92	1.78	"
45.90	1.86	$KOH \cdot 2H_2O + K_3PO_4 \cdot 3H_2O$
45.75	1.85	"
43.20	3.75	$K_3PO_4 \cdot 3H_2O$
41.69	9.04	"
41.53	9.52	$K_3PO_4 \cdot 3H_2O + K_3PO_4 \cdot 7H_2O$
41.50	9.57	"
*41.67	9.61	$K_3PO_4 \cdot 3H_2O$
*41.63	11.78	"
*41.55	13.51	"
*41.50	14.56	"
*41.70	15.19	"
*41.58	15.23	"
*41.56	15.45	"
*41.87	16.54	"
*42.01	17.44	"
*42.12	17.69	"
*42.44	20.78	"
*43.34	26.75	$K_3PO_4 \cdot 3H_2O + K_2HPO_4$
37.18	8.15	$K_3PO_4 \cdot 7H_2O$
34.39	10.99	"
29.20	7.25	$K_3PO_4 \cdot 7H_2O$
29.16	6.76	"
33.19	2.12	"
38.16	1.74	"
40.16	2.11	"
41.82	2.70	$K_2PO_4 \cdot 7H_2O + KOH \cdot 2H_2O$
*36.23	21.04	$K_3PO_4 \cdot 9H_2O$
*33.65	18.74	"
*32.65	17.45	"
*31.70	15.92	"
*31.18	14.40	"
*31.40	12.26	"
*31.52	12.00	"
*32.24	11.16	"
*36.82	11.00	"
*41.75	16.67	$K_3PO_4 \cdot 3H_2O$
*40.93	12.52	"
*41.14	5.92	"
*41.86	3.66	"
*42.30	2.99	$KOH \cdot 2H_2O$
*41.95	2.62	"
*41.80	2.17	"
*41.68	1.50	"
*41.01	0.0	"
34.06	16.70	$K_3PO_4 \cdot 7H_2O$
39.42	24.17	$K_3PO_4 \cdot 7H_2O + K_3HPO_4 \cdot 3H_2O$
*41.48	25.62	$K_3PO_4 \cdot 7H_2O$
*41.64	27.21	K_2HPO_4
*41.07	27.46	"
*40.40	28.12	"
*40.22	27.79	"
*37.59	30.03	"
*37.20	30.72	"
*36.96	30.65	"
*41.90	24.89	$K_3HPO_4 \cdot 3H_2O$
*40.33	24.62	"
36.69	24.37	$K_3HPO_4 \cdot 3H_2O$
34.15	25.48	"
34.05	25.52	"
34.22	26.02	"
34.13	26.39	"
34.22	26.90	"
34.55	27.57	"
34.92	28.90	"
*37.46	29.47	$K_2HPO_4 \cdot KH_2PO_4 \cdot 3H_2O$
*35.84	28.95	"
35.53	29.09	$K_2HPO_4 \cdot KH_2PO_4 \cdot 3H_2O + K_2HPO_4 \cdot 3H_2O$

*Metastable

Gms. K_2O per 100 gms. Sat. Sol.	Gms. P_2O_5 per 100 gms. Sat. Sol.	Solid Phase

Results at 25° (Con.)

35.51	28.96	$K_2HPO_4 \cdot KH_2PO_4 \cdot 3H_2O$
35.16	29.01	$K_2HPO_4 \cdot KH_2PO_4 \cdot 3H_2O$ + $K_2HPO_4 \cdot 3H_2O$
35.01	29.19	$K_2HPO_4 \cdot KH_2PO_4 \cdot 3H_2O$
34.48	29.39	"
33.32	28.30	KH_2PO_4
32.65	27.75	"
31.30	27.12	"
26.33	24.23	"
20.12	19.67	"
17.68	18.13	"
14.20	15.89	"
11.66	13.37	"
7.77	10.73	"
7.14	10.45	"
6.87	10.17	"
6.90	11.00	"
7.06	11.44	"
7.08	12.12	"
8.49	20.35	"
9.52	26.89	"
10.19	32.90	"
11.69	42.42	"
12.50	46.38	"
*12.68	47.40	KH_2PO_4
*12.91	49.90	"
*13.67	50.76	"
*14.27	52.78	"
*14.29	53.94	"
12.77	47.16	KH_2PO_4 + $KH_5(PO_4)_2$
11.83	47.73	$KH_5(PO_4)_2$
10.27	48.66	"
9.69	49.40	"
8.36	51.58	"
8.10	51.91	"
6.99	55.23	"
6.85	56.80	"
8.36	65.08	"
8.76	65.94	"
0.0	64.41	$2H_3PO_4 \cdot H_2O$
0.46	64.40	"
1.13	64.83	"
1.27	64.86	"
1.93	65.03	"
2.35	65.16	"
0.89	67.55	"

Results at 50°

48.83	0.0	$KOH \cdot H_2O$
49.44	2.13	$KOH \cdot H_2O$ + $K_3PO_4 \cdot 3H_2O$
*50.19	2.60	$K_3PO_4 \cdot 3H_2O$
46.60	2.64	"
46.50	2.95	"
44.88	4.70	"
43.12	7.80	"
42.35	12.36	"
42.30	15.64	"
42.25	21.07	"
42.89	23.55	"
43.80	25.64	$K_3PO_4 \cdot 3H_2O$ + K_2HPO_4
42.39	26.14	K_2HPO_4
41.72	26.92	"
41.39	26.87	"
40.98	27.49	"
40.84	27.59	"
40.01	27.90	"
39.68	28.48	"
39.73	28.59	"
39.52	28.59	"
39.18	28.86	"
38.98	29.29	"
38.72	29.64	"
*38.70	30.00	?
38.12	31.13	K_2HPO_4 + $K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$ (?)
37.96	31.24	
*37.97	31.79	K_2HPO_4
38.50	29.60	$3K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$(?)
36.71	31.42	"
*?38.93	30.57	$K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$ (?)
*?38.83	30.74	"
38.06	30.78	K_2HPO_4 + $K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$(?)
36.65	31.02	$K_2HPO_4 \cdot KH_2PO_4 \cdot 2H_2O$
36.61	31.38	"
35.69	31.91	"
35.77	31.10	KH_2PO_4
35.58	31.16	"
35.54	31.30	"
35.35	31.44	"
34.00	30.30	"
33.79	29.93	"
33.70	30.25	"
32.80	29.69	"
31.80	29.08	"
27.91	26.78	"
25.60	25.20	"
25.25	24.80	"
21.78	22.71	"
12.56	17.01	"
10.63	15.31	"
10.06	15.15	"
10.15	15.30	"
10.32	15.56	"
10.48	17.87	"

*Metastable

Gms. K_2O per 100 gms. Sat. Sol.	Gms. P_2O_5 per 100 gms. Sat. Sol.	Solid Phase	Gms. K_2O per 100 gms. Sat. Sol.	Gms. P_2O_5 per 100 gms. Sat. Sol.	Solid Phase
		Results at 50° (Con.)			
10.71	19.42	KH_2PO_4	14.34	51.15	$KH_5(PO_4)_2$
11.11	25.51	"	5.65	55.84	"
12.03	30.40	"	9.53	55.72	"
12.24	31.94	"	8.84	57.92	"
12.96	39.74	"	8.71	58.17	"
13.22	40.85	"	8.68	60.24	"
14.21	49.71	"	9.10	62.48	"
14.30	49.87	"	10.05	65.93	"

The system is discussed, and crystallographic data given, by Berg and Bokii, 1940.

PO POTASSIUM METAPHOSPHATE KPO_3

Madorsky and Clark, 1940 produced potassium metaphosphate from the action of H_3PO_4 on KCl at 120° - 130°. The product was washed to remove soluble impurities, and the solubility of KPO_3 in water was found to be 0.0041 gms. per 100 ml. of saturated solution at 25°.

The specific volume of each component in the system $KPO_3 + Na_2B_4O_7$ was determined by Leontiewa, 1937.

PO POTASSIUM PHOSPHATE K_3PO_4

SOLUBILITY OF K_3PO_4 IN WATER
(Ravich, 1938)

t°	Gms. K_3PO_4 per 100 gms. Sat. Sol.	Moles K_3PO_4 per 100 moles Sat. Sol.	Solid Phase	t°	Gms. K_3PO_4 per 100 gms. Sat. Sol.	Moles K_3PO_4 per 100 moles Sat. Sol.	Solid Phase
-1.18	4.54	0.40	Ice	44.5	60.84	11.64	$K_3PO_4 \cdot 7H_2O$
-2.60	9.75	0.91	"	45.4	61.94	12.13	"
-4.6	15.43	1.52	"	45.6	62.51	12.39	"
-7.7	21.74	2.30	"	45.6	63.12	12.68	"
-12.0	27.34	3.09	"	45.4	-	-	$K_3PO_4 \cdot 7H_2O$ + $K_3PO_4 \cdot 3H_2O$
-15.8	31.53	3.76	"				
-20.0	35.12	4.39	"	*25.0	63.17	12.70	$K_3PO_4 \cdot 3H_2O$
-24.0	38.33	5.00	Ice + $K_3PO_4 \cdot 9H_2O$	*30.0	63.19	12.71	"
*-28.2	40.25	5.40	Ice + $K_3PO_4 \cdot 7H_2O$	*35.0	63.33	12.77	"
-8.8	42.92	6.00	$K_3PO_4 \cdot 7H_2O$	*40.0	63.41	12.81	"
0	44.26	6.31	"	*45.0	63.56	12.89	"
10.0	46.83	6.95	"	50.0	63.80	13.00	"
20.0	49.62	7.71	"	60.0	64.08	13.14	"
25 0	51.42	8.23	"	*-7.7	43.85	6.21	$K_3PO_4 \cdot 9H_2O$
30.0	53.08	8.75	"	* 0	47.62	7.16	"
35.0	55.43	9.54	"	* 5.0	49.80	7.76	"
40.0	57.51	10.30	"	* 8.8	52.23	8.49	"
42.6	59.46	11.06	"	*12.3	57.72	10.00	"

* = Metastable

POTASSIUM MONOHYDROGEN PHOSPHATE K_2HPO_4

SOLUBILITY OF K_2HPO_4 IN WATER
(Ravich , 1938)

t°	Gms. K_2HPO_4 per 100 gms. Sat. Sol.	Moles K_2HPO_4 per 100 moles Sat. Sol.	Solid Phase
-4.2	16.78	2.04	Ice
-6.4	23.60	3.09	"
-9.0	29.61	4.17	"
-11.7	34.10	5.07	"
-13.5	36.78	5.67	Ice + $K_2HPO_4 \cdot 6H_2O$
0	46.11	8.12	$K_2HPO_4 \cdot 6H_2O$
4.95	50.12	9.40	"
9.7	54.43	10.99	"
13.15	57.89	12.44	"
14.3	-	-	$K_2HPO_4 \cdot 6H_2O$ + $K_2HPO_4 \cdot 3H_2O$
*14.6	60.82	13.82	$K_2HPO_4 \cdot 6H_2O$
*14.85	61.73	14.29	"
*14.7	62.96	14.94	"
*12.8	65.95	16.68	"
* 8.2	69.09	18.75	"
* 0	57.05	12.01	$K_2HPO_4 \cdot 3H_2O$
*10.0	59.08	12.96	"
15.0	60.16	13.49	"
20.0	61.52	14.16	"
25.0	62.74	14.83	"
30.0	64.13	15.60	"
35.0	65.68	16.51	"
39.5	67.54	17.68	"
44.0	69.83	19.29	"
46.0	71.26	20.42	"
48.3	-	-	$K_2HPO_4 \cdot 3H_2O$ + K_2HPO_4
51.0	72.64	21.55	K_2HPO_4
56.0	72.50	21.38	"
63.0	72.79	21.66	"

* = Metastable

SOLUBILITY OF POTASSIUM MONOHYDROGEN PHOSPHATE IN WATER
(Selva, 1947)

t°	Gms. K_2HPO_4 per 100 gms. Sat. Sol.	Gms. K_2HPO_4 per 100 gms. H_2O	Solid Phase
-4.2	16.44	19.55	Ice
-7.4	25.92	34.52	"
-11.6	34.05	51.63	"
-13.9	36.67	57.90	Ice + $K_2HPO_4 \cdot 6H_2O$
-10	38.80	63.39	$K_2HPO_4 \cdot 6H_2O$
0	45.58	83.74	"
*0	57.28	134.00	$K_2HPO_4 \cdot 3H_2O$
10.2	53.94	117.12	$K_2HPO_4 \cdot 6H_2O$
*10.2	58.86	143.00	$K_2HPO_4 \cdot 3H_2O$
13.4	57.63	136.02	$K_2HPO_4 \cdot 6H_2O$
*13.4	59.76	148.50	$K_2HPO_4 \cdot 3H_2O$
14.7	60.20	151.26	$K_2HPO_4 \cdot 6H_2O$ + $K_2HPO_4 \cdot 3H_2O$
17.2	60.30	151.90	$K_2HPO_4 \cdot 3H_2O$
25	62.03	163.37	"

Data of Selva, 1947 (Con.)

t°	Gms. K_2HPO_4 per 100 gms. Sat. Sol.	Gms. K_2HPO_4 per 100 gms. H_2O	Solid Phase
*28.7	71.63	252.50	K_2HPO_4
34	64.56	182.17	$K_2HPO_4 \cdot 3H_2O$
44.2	68.95	222.06	"
*44.2	71.50	250.90	K_2HPO_4
46.2	70.76	242.00	$K_2HPO_4 \cdot 3H_2O$
48.3	71.90	255.90	$K_2HPO_4 \cdot 3H_2O + K_2HPO_4$
51	72.04	257.64	K_2HPO_4
64.8	72.53	264.05	"
84.5	72.83	268.07	"
99.4	73.80	681.70	"

*Metastable

PO

EQUILIBRIUM IN THE SYSTEM $K_2HPO_4 + Na_2HPO_4 + H_2O$

(Ravich and Popova, 1942)

Gms. K_2HPO_4 per 100 gms. Sat. Sol.	Gms. Na_2HPO_4 per 100 gms. Sat. Sol.	Solid Phase
	Results at 0°	
0.0	1.80	$Na_2HPO_4 \cdot 12H_2O$
25.57	3.24	"
31.84	3.66	"
35.17	3.94	"
39.41	5.82	$Na_2HPO_4 \cdot 12H_2O + KNaHPO_4 \cdot 5H_2O$
40.83	5.42	$KNaHPO_4 \cdot 5H_2O$
44.59	4.38	$KNaHPO_4 \cdot 5H_2O + K_2HPO_4 \cdot 6H_2O$
*53.41	2.98	$KNaHPO_4 \cdot 5H_2O$
*55.61	2.86	$KNaHPO_4 \cdot 5H_2O + K_2HPO_4 \cdot 3H_2O$
*55.60	2.92	"
	Results at 25°	
60.66	2.36	$K_2HPO_4 \cdot 3H_2O$
59.68	4.60	"
57.85	7.14	$K_2HPO_4 \cdot 3H_2O + KNaHPO_4 \cdot 5H_2O$
54.94	7.66	$KNaHPO_4 \cdot 5H_2O$
45.31	9.91	"
30.98	17.80	"
29.57	19.05	"
26.64	21.82	$KNaHPO_4 \cdot 5H_2O + Na_2HPO_4 \cdot 7H_2O$
26.61	22.04	"
26.31	21.76	"
26.72	21.84	"
26.63	21.48	"
25.84	22.02	"
23.13	21.40	$Na_2HPO_4 \cdot 7H_2O + Na_2HPO_4 \cdot 12H_2O$
23.54	20.78	"
23.12	21.72	$Na_2HPO_4 \cdot 12H_2O$
18.80	16.94	"
10.87	14.46	"
6.42	13.20	"
0.0	10.80	"

* = Metastable

0.02 gms. of K_2HPO_4 are dissolved in 100 gms. of a saturated solution in furfural at 25° - Trimble, 1941.

POTASSIUM DIHYDROGEN PHOSPHATE KH_2PO_4

SOLUBILITY OF POTASSIUM DIHYDROGEN PHOSPHATE IN WATER

(Bergman and Batchkareff, 1938)

Gms. KH_2PO_4 per 100 gms. Sat. Sol.	t°	Solid Phase	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	t°	Solid Phase
4	0.7	Ice	12	0.8	KH_2PO_4
8	-1.5	"	16	13.6	"
10	-2.1	"	18	19.8	"
11.7	-2.6	Ice + KH_2PO_4	20	26.0	"
12.12*	-2.5	"	22	31.8	"

*Polosin and Ozolin, 1940

EQUILIBRIUM IN THE SYSTEM KH_2PO_4 - $NH_4H_2PO_4$ - H_2O AT 25°

(Kuznetsov, Kozbukhovskii, and Borovaya, 1948)

Saturated Solution Wt. %		Solid Phase Wt. %		
KH_2PO_4	$NH_4H_2PO_4$	KH_2PO_4	$NH_4H_2PO_4$	H_2O
20.21	0.0			
17.53	7.85	53.90	7.49	29.61
16.19	13.05			
15.48	15.84			
14.27	17.53	56.70	29.66	13.64
13.08	20.12			
7.97	24.48	11.22	40.53	48.25
0.0	28.85			

EQUILIBRIUM IN THE SYSTEM POTASSIUM DIHYDROGEN PHOSPHATE - AMMONIUM DIHYDROGEN PHOSPHATE - WATER AT 50°

(Zvorikin and Kuzetzov, 1938)

Liquid				Solid	
Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.	Moles KH_2PO_4 per 100 moles Sat. Sol.	Moles $NH_4H_2PO_4$ per 100 moles Sat. Sol.	Moles KH_2PO_4 per 100 moles Solid Phase	Moles $NH_4H_2PO_4$ per 100 moles Solid Phase
28.09	0.0	4.91	0.0	100.	0.0
25.23	9.49	4.76	2.12	87.33	12.67
18.97	25.91	4.07	6.58	51.60	48.40
15.92	29.12	3.41	7.40	56.82	43.18
14.38	30.96	3.10	7.89	-	-
11.79	33.22	2.52	8.42	26.37	73.63
7.69	35.19	1.60	8.66	11.28	88.72
3.45	38.42	0.71	9.31	6.64	93.36
0.0	39.88	0.0	9.41	0.0	100.00

Specific heats of solutions in the system KH_2PO_4 - $NH_4H_2PO_4$ - H_2O at 25°, 50°, and 75° were determined by Voskresenskaja and Ruzkow, 1940.

EQUILIBRIUM IN THE SYSTEM POTASSIUM DIHYDROGEN PHOSPHATE - AMMONIUM NITRATE - WATER

(Bergman, Botchkareff, 1938)

[Solubility of Potassium Dihydrogen Phosphate in Solutions of Ammonium Nitrate and vice versa]

Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase
Results at -10°		
27.2	0.0	Ice
21.8	6.4	Ice + $NH_4H_2PO_4$
28.6	4.8	$NH_4H_2PO_4$
38.6	3.5	"
45.0	2.5	$NH_4H_2PO_4$ + NH_4NO_3
47.1	0.0	NH_4NO_3
Results at 10°		
0.0	15.0	KH_2PO_4
3.3	16.5	"
6.5	17.8	"
8.0	18.4	"
11.4	18.5	$NH_4H_2PO_4$
13.2	17.5	"
15.0	16.5	"
17.0	14.4	"
27.5	8.1	"
38.0	5.0	"
48.5	2.9	"
59.2	1.2	NH_4NO_3 + $NH_4H_2PO_4$
59.6	0.0	NH_4NO_3
Results at 30°		
0.0	21.4	KH_2PO_4
3.1	21.8	"
6.2	22.3	"
7.7	22.5	"
10.7	22.8	"
12.3	23.0	"
13.6	22.8	$NH_4H_2PO_4$
15.6	21.8	"
18.4	19.6	"
23.0	15.4	"
25.9	13.3	"
36.7	8.2	" (-5.6°) 6.8
47.7	4.4	" (-8.7°) 18.3
58.0	3.3	" (-15.8°) 40.4
68.9	1.3	NH_4NO_3 + $NH_4H_2PO_4$
69.7	0.0	NH_4NO_3

Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase
Results at 0°		
0.0	12.2	KH_2PO_4
3.4	14.0	"
8.0	16.6	KNO_3
6.6	15.9	"
8.3	16.2	KNO_3 + KH_2PO_4
12.0	13.7	KNO_3
13.9	13.0	"
15.7	12.6	"
16.4	12.5	KNO_3 + $NH_4H_2PO_4$
17.7	11.4	$NH_4H_2PO_4$
28.1	6.2	"
38.4	3.9	"
48.8	2.4	"
52.7	1.6	NH_4NO_3
53.5	0.0	"
Results at 20°		
0.0	18.2	KH_2PO_4
3.2	19.1	"
6.4	19.8	"
7.9	20.1	"
11.0	20.5	"
12.7	20.5	$NH_4H_2PO_4$
14.4	19.5	"
16.4	17.8	"
18.3	16.3	"
26.8	10.4	"
37.4	6.3	"
48.2	3.6	"
58.6	2.2	"
63.0	1.0	NH_4NO_3 + $NH_4H_2PO_4$
65.0	0.0	NH_4NO_3
Additional Data		
14.3		Ice + KNO_3 + KH_2PO_4
8.6		Ice + KNO_3 + $NH_4H_2PO_4$
3.2		Ice + NH_4NO_3 + $NH_4H_2PO_4$

EQUILIBRIUM IN THE SYSTEM POTASSIUM DIHYDROGEN PHOSPHATE - UREA - WATER

(Polosin , Sachparonov, 1947)

The results are also given in mole %.

Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase
	Results at -10°	
0.0	30.70	Ice
2.00	29.70	"
2.92	27.10	"
6.86	23.80	"
7.60	27.72	KH_2PO_4
6.16	31.60	$CO(NH_2)_2$
2.69	32.60	"
0.0	33.50	
	Results at 10°	
14.95	0.0	KH_2PO_4
13.25	8.67	"
11.60	17.68	"
10.00	27.00	"
8.20	36.70	"
7.40	41.65	"
5.06	43.70	$CO(NH_2)_2$
2.20	45.10	"
0.0	46.00	"
	Results at 25°	
19.80	0.0	KH_2PO_4
17.10	8.29	"
14.40	17.12	"
12.20	26.34	"
9.70	36.10	"
8.50	41.15	"
8.00	46.00	"
4.32	52.00	$CO(NH_2)_2$
1.86	53.40	"
0.0	54.50	"
	Invariant Points	
0.0	33.00	Ice + $CO(NH_2)_2$
0.0	53.30	α-$CO(NH_2)_2$ + β-$CO(NH_2)_2$
11.70	0.0	Ice + KH_2PO_4
7.00	29.70	Ice + $CO(NH_2)_2 \cdot KH_2PO_4$
7.20	37.50	α-$CO(NH_2)_2$ + β-$CO(NH_2)_2$ + KH_2PO_4

Gms. KH_2PO_4 per 100 gms. Sat. Sol.	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 0°	
12.15	0.0	KH_2PO_4
10.65	8.93	"
9.95	18.10	"
8.80	27.36	"
5.60	37.70	$CO(NH_2)_2$
2.45	38.80	"
0.0	39.80	"
	Results at 20°	
18.20	0.0	KH_2PO_4
15.85	8.41	"
10.40	17.32	"
11.40	26.58	"
9.20	36.30	"
8.00	41.40	"
7.60	46.20	"
4.57	49.20	$CO(NH_2)_2$
1.97	50.60	"
0.0	51.80	
	Results at 35°	
22.90	0.0	KH_2PO_4
19.70	8.03	"
16.70	16.66	"
14.40	25.80	"
11.20	35.50	"
9.80	40.55	"
8.70	45.65	"
8.00	50.60	"
3.82	57.50	$CO(NH_2)_2$
1.64	59.00	"
0.0	59.50	"

ReO POTASSIUM PERRHENATE $KReO_4$

SOLUBILITY IN WATER
(Smith, 1946)

The results agree well with those of other authors (Vol. I, p. 856).

t°	Gms. $KReO_4$ per 100 gms. H_2O	Moles $KReO_4$ per 100 gms. H_2O
0	0.36	0.00124
30	1.47	.00508
40	2.22	.00767
49.78	3.21	.0111

SO POTASSIUM SULFATE K_2SO_4

SOLUBILITY OF POTASSIUM SULFATE IN AMMONIA SOLUTIONS
(Guyer, Bieler, and Orelli, 1940)

The data below were estimated from curves drawn by the authors, and are given in grams per 100 grams of solvent.

% NH_3 in Solvent	-30°	-10°	0°	23°
5	-	2.2	2.7 (7% NH_3)	4.7
10	-	1.2	0.75	2.0
15	0.25	0.6	.5	1.0
20	.2	.2	.4	0.6
40	.2	.1	.4	.5
60	.2	.1	.4	.5
80	.2	.1	.3	.5

SOLUBILITY OF POTASSIUM SULFATE IN AMMONIA SOLUTIONS AT 25°
(Hill and Louchs, 1937)

	Gms. per 100 gms. Sat. Sol.					
NH_3	0	13.90	18.20	22.35	24.83	27.04
K_2SO_4	10.80	1.286	0.639	0.421	0.220	0.149

100 gms. of a solution saturated with both NH_3 and KCl at 25° contains 15.26 gms. KCl and 23.65 gms. NH_3. (Hill and Louchs, 1937)

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE - SODIUM SULFATE - WATER AT 25°
(Makarov and Druzhinin, 1937)

Saturated Solution				Solid Phase			
Gms. per 100 gms. Sat. Sol.		Moles per 100 moles Dissolved Salts		Gms. per 100 gms. Solid		Moles per 100 moles Solid	
Na_2SO_4	K_2SO_4	Na_2SO_4	K_2SO_4	Na_2SO_4	K_2SO_4	Na_2SO_4	K_2SO_4
21.92	0.0	100.0	0.0	44.25	0.0	(Pure $Na_2SO_4 \cdot 10H_2O$)	
20.35	6.60	79.09	20.91	44.25	0.0		
20.18	7.11	77.69	22.31	25.00	75.00	29.01	70.99
19.93	7.06	77.59	22.41	24.20	75.80	28.14	71.86
15.94	8.25	70.32	29.68	23.21	76.79	27.04	72.96
11.65	9.07	61.18	38.82	22.00	78.00	25.70	74.30
7.96	9.91	49.62	50.38	21.50	78.50	25.14	74.86
*5.43	11.44	36.80	63.20	21.40	78.60	25.00	75.00
0.0	10.76	0.0	100.0	0.0	100.0	0.0	100.0

*Solutions containing 0 - 5% Na_2SO_4 are in equilibrium with pure K_2SO_4.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE - BORIC ACID - WATER

(Perova, 1988)

The data are also reported in molar units. The eutectic occurs at -2.0°; 6.6% K_2SO_4, 3.1% H_3BO_3.

Gms. H_3BO_3 per 100 gms. Sat. Sol.	Gms. K_2SO_4 per 100 gms. Sat. Sol.	Solid Phase
Results at 0°		
2.59	0.0	H_3BO_3
2.70	1.94	"
2.90	3.88	"
2.99	4.85	"
3.08	5.80	"
3.20	6.78	"
3.25	7.50	$H_3BO_3 + K_2SO_4$
0.0	6.89	K_2SO_4
Results at 5°		
3.08	0.0	H_3BO_3
3.10	1.93	"
3.30	3.86	"
3.30	4.83	"
3.39	5.79	"
3.50	6.76	"
4.0	9.20	$H_3BO_3 + K_2SO_4$
0.0	7.67	K_2SO_4
Results at 10°		
3.50	0.0	H_3BO_3
3.58	1.92	"
3.65	3.85	"
3.73	4.81	"
3.80	5.77	"
3.90	6.72	"
4.00	9.64	"
4.60	9.56	"
4.62	9.62	"
4.70	9.90	$H_3BO_3 + K_2SO_4$
0.0	8.45	K_2SO_4
Results at 15°		
4.20	0.0	H_3BO_3
4.22	1.91	"
4.34	3.82	"
4.40	4.78	"
4.46	5.73	"
4.54	6.68	"
5.00	9.59	"
5.32	10.41	"
2.62	9.78	$H_3BO_3 + K_2SO_4$
0.0	9.22	K_2SO_4
Results at 20°		
4.86	0.0	H_3BO_3
4.90	1.90	"
5.00	3.80	"
5.08	4.74	"
5.12	5.69	"
5.20	6.63	"
5.60	9.44	"
5.90	10.35	"
5.30	10.53	$H_3BO_3 + K_2SO_4$
0.0	10.00	K_2SO_4
Results at 25°		
5.60	0.0	H_3BO_3
5.60	1.88	"
5.65	3.77	"
5.70	4.71	"
5.80	5.64	"
5.90	6.59	"
6.35	9.36	"
6.80	10.24	"
7.20	10.80	$H_3BO_3 + K_2SO_4$
3.40	10.72	K_2SO_4
0.0	10.75	"

Data for solutions in equilibrium with continuous solid solutions in the system K_2SO_4 - $(NH_4)_2SO_4$ - H_2O from the eutectic temperature to 30° is given by Bergman and Shelokhovich, 1942.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE - UREA - WATER

(Blidin, 1947)

t°	Gms. $CO(NH_2)_2$ per 100 gms. Sat. Sol.	Gms. K_2SO_4 per 100 gms. Sat. Sol.	Solid Phase
-12.4	31.1	3.8	Ice + $CO(NH_2)_2$
-9.0	35	0.0	$CO(NH_2)_2$
-8.6	34.2	1.9	"
-8.2	33.9	3.2	"
-6.0	35.0	3.4	"
-3.0	36.6	3.1	"
-2.0	40.0	0.0	"
-1.2	39.0	2.4	"
-0.4	37.9	5.1	"
11.0	45.0	3.0	"
20	50.0	2.8	"
24	52.5	2.8	"
-7.6	33.1	4.9	$CO(NH_2)_2$ + K_2SO_4
-0.2	37.8	5.2	"
-8.2	18.9	5.3	Ice
-8	20	4.9	"
-7.2	19.3	3.1	"
-6.8	19.7	1.50	"
-6.4	20.0	0.0	"
-4.6	10	4.9	"
-1.2	0.0	5.0	"
-8.6	18.6	6.1	Ice + K_2SO_4
1.0	18.4	6.7	K_2SO_4
5.0	32.9	5.5	"
12.0	18.2	7.4	"
13.0	37.7	5.66	"
16.0	32.8	6.0	"
22.0	18.0	8.1	"
25.0	32.8	6.1	"
25.0	37.7	6.0	"

SO

EQUILIBRIUM IN SYSTEMS OF POTASSIUM SULFATE WITH MAGNESIUM SULFATE, SODIUM SULFATE, AND WATER AT 35°

(Bayliss, Cole, Ewers, and Jones, 1947)

$K_2SO_4 + Na_2SO_4 + H_2O$

Gms. K_2SO_4 per 100 gms. H_2O	Gms. Na_2SO_4 per 100 gms. H_2O	Solid Phase	Gms. K_2SO_4 per 100 gms. H_2O	Gms. Na_2SO_4 per 100 gms. H_2O	Solid Phase
13.80	0.0	K_2SO_4	11.10	19.45	$3K_2SO_4 \cdot Na_2SO_4$
14.05	1.10	"	10.65	19.95	"
14.00	2.55	"	10.15	24.65	"
14.30	2.50	"	10.05	26.80	"
14.40	3.60	"	9.55	29.30	"
14.80	4.75	"	9.15	33.15	"
14.75	5.15	"	9.00	34.85	"
14.45	6.10	"	8.30	40.30	"
14.70	7.00	$K_2SO_4 + 3K_2SO_4 \cdot Na_2SO_4$	7.45	48.00	$3K_2SO_4 \cdot Na_2SO_4 + Na_2SO_4$
13.45	9.00	$3K_2SO_4 \cdot Na_2SO_4$	3.95	48.15	Na_2SO_4
12.60	12.25	"	2.30	47.85	"
11.90	14.50	"	0.0	49.15	"

Data of Bayliss, Cole, Ewers, and Jones, 1947 (Con.)

$K_2SO_4 + MgSO_4 + H_2O$

Gms. K_2SO_4 per 100 gms. H_2O	Gms. $MgSO_4$ per 100 gms. H_2O	Solid Phase	Gms. K_2SO_4 per 100 gms. H_2O	Gms. $MgSO_4$ per 100 gms. H_2O	Solid Phase
13.80	0.0	K_2SO_4	10.45	30.70	$K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$
14.50	4.55	"	8.05	37.45	"
15.90	9.85	"	6.55	42.35	$K_2SO_4 \cdot MgSO_4 \cdot 6H_2O + MgSO_4 \cdot 7H_2O$
16.30	18.40	$K_2SO_4 + K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$	3.35	41.45	$MgSO_4 \cdot 7H_2O$
13.30	24.25	$K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$	0.0	41.65	"

SO

$K_2SO_4 + MgSO_4 + Na_2SO_4 + H_2O$

Gms. per 100 gms. H_2O			Solid Phase	Gms. per 100 gms. H_2O			Solid Phase
Na_2SO_4	K_2SO_4	$MgSO_4$		Na_2SO_4	K_2SO_4	$MgSO_4$	
44.05	7.65	5.30	Na_2SO_4 + G	9.30	13.55	21.85	G + S
42.10	7.45	7.55	"	7.00	15.20	20.05	"
40.90	7.65	9.30	"	5.75	16.15	18.15	K_2SO_4 + G + S
38.85	7.65	12.90	"	2.90	15.85	18.90	K_2SO_4 + S
36.50	7.55	16.50	"	5.75	16.05	15.15	K_2SO_4 + G
36.10	7.55	17.55	Na_2SO_4 + G + A	5.30	16.15	11.20	"
36.60	5.50	17.30	Na_2SO_4 + A	6.15	15.85	5.75	"
36.80	2.15	17.15	"	20.95	8.70	30.15	A + S
34.30	7.65	18.10	G + A	17.80	7.95	33.20	"
29.90	8.10	21.85	"	13.95	6.60	37.40	"
24.50	8.50	26.00	"	12.75	6.50	39.80	$MgSO_4 \cdot 7H_2O$ + A + S
21.35	8.80	29.20	G + A + S	13.10	3.30	39.20	$MgSO_4 \cdot 7H_2O$ + A
17.95	9.95	27.60	G + S	9.05	6.60	41.30	$MgSO_4 \cdot 7H_2O$ + S
15.00	11.00	25.85	"	4.50	6.60	41.40	"

A = Astrakanite = $MgSO_4 \cdot Na_2SO_4 \cdot 4H_2O$
G = Glaserite = $Na_2SO_4 \cdot 3K_2SO_4$
S = Schönite = $MgSO_4 \cdot K_2SO_4 \cdot 6H_2O$

Data on the system $MgSO_4 + Na_2SO_4 + H_2O$ are given in the same paper.

EQUILIBRIUM IN THE SYSTEM POTASSIUM SULFATE - SODIUM SULFATE - AMMONIUM SULFATE - WATER AT 0°, 25°, 40°

(Belopolsky and Shpunt, 1945)

γ-Glaserite = $K_3Na(SO_4)_2$ forming solid solutions with Na_2SO_4.
$(K, NH_4)_2SO_4$ = Continuous solid solutions of K_2SO_4 + $(NH_4)_2SO_4$.

Gms. per 100 gms. Sat. Sol.			Gms. per 100 gms. Solid			Solid Phase
Na_2SO_4	$(NH_4)_2SO_4$	K_2SO_4	Na_2SO_4	$(NH_4)_2SO_4$	K_2SO_4	
			Results at 40°			
30.31	0.0	5.32	36.87	1.07	59.91	Na_2SO_4 + γ-Glaserite
28.43	4.39	4.84	39.93	2.00	59.15	"
26.79	8.48	4.12	41.62	2.89	53.73	"
25.15	12.27	3.70	43.93	4.36	50.00	"
22.69	17.87	3.40	41.20	19.75	27.39	Na_2SO_4 + γ-Glaserite + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
23.06	19.35	0.0	-	-	-	Na_2SO_4 + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
10.34	38.26	0.0	-	-	-	$(NH_4)_2SO_4$ + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
11.05	35.57	1.69	17.81	67.73	8.39	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + $(K,NH_4)_2SO_4$
11.34	34.96	1.78	12.65	59.65	24.94	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + $(K,NH_4)_2SO_4$ + γ-Glaserite
19.44	21.53	2.65	34.22	27.23	23.98	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + γ-Glaserite
17.04	25.08	2.28	31.72	26.90	28.09	"
14.56	28.65	2.04	30.39	28.14	30.73	"
5.93	0.0	12.42	14.66	0.0	85.27	γ-Glaserite + $(K,NH_4)_2SO_4$
5.80	4.61	11.63	12.90	1.84	84.89	"
5.84	8.70	11.03	10.24	3.24	86.84	"
5.66	15.50	9.74	-	-	-	"
5.20	26.55	6.79	10.58	19.51	69.17	"
7.82	35.53	3.54	16.14	42.80	39.46	"
			Results at 25°			
22.25	0.0	6.60	30.12	0.0	68.68	$Na_2SO_4 \cdot 10H_2O$ + γ-Glaserite
23.30	4.86	5.20	33.22	1.40	32.41	"
22.95	6.15	4.60	-	-	-	"
25.25	12.25	2.84	38.16	14.18	18.06	$Na_2SO_4 \cdot 10H_2O$ + γ-Glaserite + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
24.85	13.09	1.95	-	-	-	$Na_2SO_4 \cdot 10H_2O$ + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
25.13	14.09	0.0	-	-	-	"
7.70	38.45	0.0	-	-	-	$(NH_4)_2SO_4$ + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
7.88	37.22	0.89	-	-	-	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + $(K,NH_4)_2SO_4$
8.26	35.47	1.85	14.30	66.77	11.31	"
8.58	34.27	2.44	26.38	43.43	22.88	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + $(K,NH_4)_2SO_4$ + γ-Glaserite
20.67	15.60	3.18	-	-	-	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + γ-Glaserite
16.20	21.06	3.23	-	-	-	"
12.99	26.11	2.73	30.96	29.13	27.49	"
5.90	0.0	10.48	-	-	-	γ-Glaserite + $(K,NH_4)_2SO_4$
6.02	5.12	9.99	10.24	1.51	88.10	"
5.91	8.39	9.51	14.13	4.58	82.49	"
6.04	9.12	9.61	9.74	2.04	87.99	"
6.17	11.10	8.94	16.32	2.60	81.45	"
6.15	15.55	8.12	15.65	8.25	75.95	"
6.03	19.61	7.01	13.53	13.52	71.57	"
5.85	23.58	5.88	13.12	16.95	68.51	"
5.66	24.24	6.22	7.55	18.51	73.11	"
5.48	30.72	4.42	-	-	-	"
5.64	30.59	3.44	-	-	-	"

Data of Belopolsky and Shpunt, 1945 (Con.)

Gms. per 100 gms. Sat. Sol.			Gms. per 100 gms. Solid			Solid Phase
Na_2SO_4	$(NH_4)_2SO_4$	K_2SO_4	Na_2SO_4	$(NH_4)_2SO_4$	K_2SO_4	
			Results at 0°			
7.60	29.37	0.0	-	-	-	$Na_2SO_4 \cdot 10H_2O$ + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
8.29	27.55	2.37	-	-	-	"
8.00	26.87	3.26	-	-	-	"
7.97	27.08	3.14	-	-	-	"
7.53	24.28	4.05	-	-	-	" + $(K,NH_4)_2SO_4$
4.47	38.22	0.0	-	-	-	$(NH_4)_2SO_4$ + $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$
5.00	36.90	0.82	-	-	-	$Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ + $(NH_4,K)_2SO_4$
5.02	35.35	1.93	-	-	-	"
5.52	33.54	2.59	-	-	-	"
6.30	31.39	3.03	-	-	-	"
6.32	26.24	3.90	-	-	-	"
7.06	24.84	4.07	-	-	-	"
5.67	0.0	7.41	-	-	-	$Na_2SO_4 \cdot 10H_2O$ + $(K,NH_4)_2SO_4$
5.46	0.0	7.80	-	-	-	"
7.11	15.60	5.40	-	-	-	"

100 gms. of a saturated solution in 50% ethyl alcohol contain 0.120 gms. K_2SO_4 at 20°.

100 gms. of a saturated solution in 50% ethyl alcohol saturated with benzene contain 0.128 gms. K_2SO_4 at 20°. (Grinberg and Zemlyakova, 1948)

The distribution of ponceau red between the solution and mixed crystals with potassium sulfate has been studied by Ioffe and Nikitin (1942a) at 0°.

Melting points are given for the following systems:

$K_2SO_4 + Na_2SO_4$	(Ferrier and Bellanca, 1940) (Bredig, 1942)
$K_2SO_4 + PbSO_4$	"
$K_2SO_4 + PbSO_4 + Na_2SO_4$	"
$K_2SO_4 + Tl_2Cl_2 + Tl_2(NO_3)_2$	(Rostovskii, 1940)

POTASSIUM CHROMIUM SULFATE $CrK_2(SO_4)_2$

SO

EQUILIBRIUM IN THE SYSTEM CHROMIUM AMMONIUM SULFATE - CHROMIUM POTASSIUM SULFATE - WATER AT 25°

(Hill, Smith, and Ricci, 1940)

Saturated Solution Wt. %		Solid Phase Wt. %		Solid Phase
$CrNH_4(SO_4)_2$	$CrK(SO_4)_2$	$CrNH_4(SO_4)_2$	$CrK(SO_4)_2$	
13.67	0.0	-	0.0	Solid Solution of $CrNH_4(SO_4)_2 \cdot 12H_2O$ + $CrK(SO_4)_2 \cdot 12H_2O$
10.28	4.612	43.12	12.08	
6.85	9.40	30.26	25.26	
4.852	12.14	21.91	34.15	
2.986	14.75	13.52	42.76	
1.162	17.30	5.226	51.32	
0.0	18.79	0.0	56.71	

POTASSIUM PERSULFATE $K_2S_2O_8$

SO

100 parts of water dissolve 2 parts $K_2S_2O_8$ at room temperature. (Elbs, 1893).

0.01 gms. of $K_2S_2O_8$ are dissolved in 100 gms. of a saturated solution in furfural at 25°.

SON POTASSIUM SULFAMATE KSO_3NH_2

SOLUBILITY OF POTASSIUM SULFAMATE IN WATER
(Ricci and Selikson, 1947)

t°	Gms. KSO_3NH_2 per 100 gms. Sat. Sol.	Solid Phase
20	40.05	KSO_3NH_2
25	43.74	"
35	50.38	"

SeO POTASSIUM SELENATE K_2SeO_4

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SELENATE - POTASSIUM SELENATE - WATER AT 25°
(Hill, Soth, and Ricci, 1940)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$MgSeO_4$	K_2SeO_4		$MgSeO_4$	K_2SeO_4	
0.0	53.26	K_2SeO_4	20.04	12.76	1:1:6
0.191	52.88	K_2SeO_4 + 1:1:6	24.08	9.79	"
0.35	50.48	1:1:6	31.11	5.77	"
1.52	41.54	"	34.38	3.58	$MgSeO_4 \cdot 6H_2O$ + 1:1:6
5.68	29.55	"	35.74	0.0	$MgSeO_4 \cdot 6H_2O$
13.91	18.30				

1:1:6 = $MgSeO_4 \cdot K_2SeO_4 \cdot 6H_2O$

Kr KRYPTON Kr

SOLUBILITY OF KRYPTON IN OLIVE OIL
(Loomis, 1946)

t°	
22	0.44
37	0.43

The solid-liquid equilibria of the systems krypton + argon and krypton + methane were determined by Veith (1937) from melting point curves.

The liquid-vapor data for the system krypton - oxygen were determined by Fastovskii and Gurvich, 1939.

Cl LANTHANUM CHLORIDE $LaCl_3$

SOLUBILITY OF LANTHANUM CHLORIDE IN WATER
(Friend and Hale, 1940)

t°	Gms. $LaCl_3$ per 100 gms. Sat. Sol.	t°	Gms. $LaCl_3$ per 100 gms. Sat. Sol.	t°	Gms. $LaCl_3$ per 100 gms. Sat. Sol.
0	48.12*	36.4	49.87	64.6	54.96
10.0	48.46	45.8	51.16	64.6	54.84
11.4	48.83	50.2	52.00	71.5	56.70
15.4	48.99	55.4	53.15	76.0	57.59
25.0	49.27	59	53.65	80.4	58.87
26.2	49.40	63.6	54.30	92.1	63.02
33.0	49.69				

*The solid phase was $LaCl_3 \cdot 7H_2O$ throughout.

SOLUBILITY OF LANTHANUM CHLORIDE IN ACID SOLUTIONS (Friend and Hale, 1940) Cl

The addition of "free acid" (hydrochloric?) decreased the solubility linearly at both temperatures.

Results at 25°		Results at 50°	
Normality Of Acid	Gms. $LaCl_3$ per 100 gms. Sat. Sol.	Normality of Acid	Gms. $LaCl_3$ per 100 gms. Sat. Sol.
0	49.27	0	52.00
0.174	48.79	0.171	51.46
.817	45.87	.400	50.88
1.471	43.55	.597	50.28
1.644	42.78	1.568	47.66
2.611	39.47	1.831	46.95

LANTHANUM FLUORIDE LaF_3 F

Melting points in the systems LaF_3 + NaF, LaF_3 + KF, LaF_3 + RbF and LaF_3 + CsF are given by Dergunov, 1948.

LANTHANUM NITRATE $La(NO_3)_3$ NO

DISTRIBUTION OF LANTHANUM NITRATE BETWEEN WATER AND n-HEXYL ALCOHOL AT 25° (Templeton, 1949)

The results were also calculated in terms of mole fractions in each phase.

Wt. % La_2O_3		Wt. % La_2O_3	
Aqueous Phase	Alcohol Phase	Aqueous Phase	Alcohol Phase
28.6	2.36	23.5	0.52
27.4	1.575	22.1	.35
26.15	1.05	21.2	.29
24.85	0.73		

The distribution coefficient of a mixture of rare earth nitrates, containing 7% lanthanum nitrate, between methyl-n-hexyl ketone and water at room temperature was found to be less than 0.0012, with 33.0% of anhydrous salt in the aqueous phase. (Rothchild, Templeton, and Hall, 1948)

10 ml. of a saturated solution of lanthanum nitrate in ether at 20° contain 0.1 mg. La_2O_3. (Wells, 1930).

LANTHANUM HYDROXIDE $Li(OH)_3$ OH

Oka, 1940 found the solubility of lanthanum hydroxide in water to be 9.2×10^{-6} moles per liter by potentiometric titration.

IO LANTHANUM IODATE $La(IO_3)_3$

SOLUBILITY OF LANTHANUM IODATE IN AQUEOUS SALT SOLUTIONS AT 25°
(Pearce and Oelke, 1938)

With KCl Added			With $MgCl_2$ Added		
Moles KCl per 1000 gms. H_2O	Moles $La(IO_3)_3$ per Liter Sat. Sol.	Density	Moles $MgCl_2$ per 1000 gms. H_2O	Moles $La(IO_3)_3$ per liter Sat. Sol.	Density
0.0000	0.0006634	0.99749	0.0010	0.000702	0.99757
.0010	.000684	.99750	.005	.000817	.99798
.005	.000737	.99776	.010	.000908	.99841
.010	.001014	.99801	.050	.001306	1.00180
.050	.001195	1.00000	.100	.001601	1.00589
.100	.001919	1.00243	.500	.002782	1.03666
.500	.002452	1.02090	1.000	.003508	1.07255
1.000	.003167	1.04277	2.000	.004209	1.13805
2.000	.003898	1.08268	3.000	.004639	1.19716
3.500		1.13787			

With K_2SO_4 Added			With $MgSO_4$ Added		
(Moles K_2SO_4)			(Moles $MgSO_4$)		
0.0010	0.000824	0.99790	0.0010	0.000846	0.99766
.005	.001215	.99847	.005	.001209	.99839
.010	.001488	.99952	.010	.001448	.99921
.050	.002568	1.00554	.050	.002384	1.00496
			.100	.003021	1.01167
			.500	.005863	1.06116
			1.000	.008198	1.12180
			1.500	.009690	1.17865
			2.000	.010558	1.23098

WO LANTHANUM TUNGSTATE $La_2(WO_3)_2$

SOLUBILITY IN WATER
(Vickery, 1949)

	Unignited		Ignited	
	20°	100°	20°	100°
Gms. per 100 ml:	0.014	0.0194	0.001	0.001

Li LITHIUM Li

The eutectic temperature in the system Li - NH_3 is about -185° (Birch and MacDonald, 1947).

The reaction Li + NaCl $\rightleftharpoons$ LiCl + Na was studied at 900° by Jellinek, 1920.

LITHIUM BROMIDE LiBr Br

EQUILIBRIUM IN THE SYSTEM LITHIUM BROMIDE - MAGNESIUM BROMIDE - WATER AT 25°

(Blidin, 1947a)

The data given below do not lie on a smooth curve, but the analyses of the wet residues indicate that the salts form solid solutions.

Saturated Solution Wt. %		Wet Residue Wt. %		Solid Phase
$MgBr_2$	LiBr	$MgBr_2$	LiBr	
50.38	0.0	-	-	$MgBr_2 \cdot 6H_2O$
44.0	8.12	58.30	2.6	$MgBr_2 \cdot 6H_2O \cdot LiBr \cdot 2H_2O$
36.52	16.69	58.7	3.8	"
33.17	23.90	58.2	6.6	"
25.30	34.40	53.1	11.9	"
20.0	39.8	48.2	20.2	"
15.50	44.9	43.1	23.2	"
4.75	56.66	36.9	26.8	"
0.0	64.71	-	-	$LiBr \cdot 2H_2O$

EQUILIBRIUM IN THE SYSTEM LITHIUM BROMIDE - LEAD BROMIDE - WATER

(Roger, 1944)

Diagrams are presented for the 0° and 25° isotherms, but numerical data are given for 25° only. The refractive indices were determined at 25°. At 50° the solubility curves have the same form as at 0° and 25°, but the field of stability of the double salt is very small.

Results at 0°

Gms. $PbBr_2$ per 100 gms. Sat. Sol.	Gms. LiBr per 100 gms. Sat. Sol.	Density	Solid Phase
0.46	0.0	-	$PbBr_2$
.037	1.4	-	"
*2	20	-	"
32.78	29.63	-	$PbBr_2 + PbBr_2 \cdot LiBr \cdot 4H_2O$
*26.5	38.5		$PbBr_2 \cdot LiBr \cdot 4H_2O$
28.21	40.70		$PbBr_2 \cdot LiBr \cdot 4H_2O + LiBr \cdot 3H_2O$
0.0	57.95	-	$LiBr \cdot 3H_2O$

*Estimated from graph.

Results at 25°

0.975	0.0	1.0049	$PbBr_2$
.845	.102	-	"
.642	.324	-	"
.321	1.11	-	"
.205	2.78	-	"
.225	4.67	-	"
.302	6.63	-	"
.530	10.80	-	"
.805	14.45	-	"
1.56	18.44	-	"
6.30	23.02	1.271	"
18.66	27.45	1.512	"
23.11	28.26	1.638	"
23.41	28.30	1.654	"

Data of Roger, 1944 (Con.)

Br

Gms. $PbBr_2$ per 100 gms. Sat. Sol.	Gms. LiBr per 100 gms. Sat. Sol.	Density	Solid Phase
		Results at 25° (Con.)	
25.52	28.38	1.703	$PbBr_2$
27.13	28.62	1.738	"
30.04	28.88	1.825	"
30.55	29.20	1.852	"
34.05	29.48	1.954	"
35.88	29.77	2.046	"
36.74	29.81	2.055	$PbBr_2 + PbBr_2 \cdot LiBr \cdot 4H_2O$
35.08	31.57	2.045	$PbBr_2 \cdot LiBr \cdot 4H_2O$
33.88	33.39	2.066	"
33.49	34.26	2.087	"
33.21	35.75	2.134	"
34.23	37.42	2.222	"
36.48	37.89	2.305	$PbBr_2 \cdot LiBr \cdot 4H_2O + LiBr \cdot 2H_2O$
31.23	41.18	2.213	$LiBr \cdot 2H_2O$
27.72	43.28	2.146	"
22.08	47.40	2.092	"
14.85	51.83	1.972	"
0.0	61.61	1.7405	"

SOLUBILITY OF LITHIUM BROMIDE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent :	Ethylene Diamine	Monoethanolamine	Ethylene Glycol
Gms. LiBr per 100 gms. Solvent:	2.41	Approx. 60	39.4

100 gms. of a saturated solution of lithium bromide in liquid SO_2 contain 0.067 gms. LiBr at 25°.

The reactions below the melting points in each of the following systems were studied by Link and Wood, 1940 by means of X-rays.

LiBr + NaI	LiBr + CsF	LiBr + RbCl
LiBr + KI	LiBr + NaF	LiBr + CsCl
LiBr + RbI	LiBr + KF	LiBr + KCl
LiBr + CsI	LiBr + RbF	LiBr + NaCl

BrO **LITHIUM BROMATE $LiBrO_3$**

SOLUBILITY OF LITHIUM BROMATE IN WATER

(Averko-Antonovich, 1948)

The author found that lithium bromate solutions would supercool as viscous syrups to as low as -70°. The results agree with those of Simmons and Waldeck (Vol. I, p. 900).

t°	Gms. $LiBrO_3$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $LiBrO_3$ per 100 gms. Sat. Sol.	Solid Phase
-1.05	10.3	Ice	20.1	64.51	$LiBrO_3 \cdot H_2O$
-4.8	20.3	"	24.9	65.54	"
-9.8	30.6	"	35.0	67.78	"
-20.0	40.0	"	45.0	70.4	"
-40.0	52.0	"	50.0	71.8	"
-47	54.5	Ice + $LiBrO_3 \cdot H_2O$	52	+72.4	$LiBrO_3 \cdot H_2O$ + $LiBrO_3$
-45.0	54.9	$LiBrO_3 \cdot H_2O$	*4	66.8	$LiBrO_3$
-40.0	55.4	"	*17.5	68.2	"
-36.7	56.2	"	*45	71.8	"
-31.5	56.8	"	55.0	72.72	"
-26.5	57.3	"	65.0	73.86	"
-21.0	58.2	"	80.0	75.84	"
-16.5	58.5	"	100.5	78.6	"
-10.8	59.4	"	111	79.6	"
-6.3	60.2	"	121	81.2	"
0	61.23	"	143	84.6	"

* = Metastable + = Estimated from author's data.

LITHIUM DIPICRYLAMIDE $Li\ (NO_2)_3C_6H_2NHC_6H_2(NO_2)_3$ CH

SOLUBILITY IN WATER

(Treadwell and Hepenstrick, 1949)

t°	Moles Salt per liter
20	0.169
25	0.181

LITHIUM PALMITATE $LiCH_3(CH_2)_{14}COO$ CH

The phase diagram of the system lithium palmitate - water was determined by Vold, 1943, and it resembles that of sodium palmitate. The effect of adding small amounts of lithium chloride to the solutions is discussed. Only the compositions of the invariant solutions are given in tabular form.

LITHIUM CARBONATE Li_2CO_3 CO

EQUILIBRIUM IN THE SYSTEM LITHIUM CARBONATE - SODIUM CARBONATE - WATER AT 25°

(Urazov and Lifatova, 1944)

The results are also given on a molar basis.

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
Li_2CO_3	Na_2CO_3		Li_2CO_3	Na_2CO_3	
1.237	0.0	Li_2CO_3	0.99	20.57	Li_2CO_3
1.18	2.07	"	.96	21.25	"
1.15	5.12	"	.93	23.40	Li_2CO_3 +
1.14	7.31	"	.917	23.51	$Na_2CO_3 \cdot 10H_2O$
1.14	9.39	"	.807	23.85	$Na_2CO_3 \cdot 10H_2O$
1.11	16.89	"	.61	23.39	"
1.16	17.94	"	.40	23.24	"
0.98	18.66	"	.20	23.19	"
0.97	18.94	"	.08	23.02	"
1.00	19.71	"	0.0	23.27	"

CO

SOLUBILITY OF LITHIUM CARBONATE IN SALT SOLUTIONS

(Lagarde, 1948)

The data were read from curves drawn by the author.

In LiCl Solutions			In Na_2CO_3 Solutions		
Gms. LiCl per liter Sat. Sol.	Gms. Li_2CO_3 per liter Sat. Sol.		Gms. Na_2CO_3 per liter Sat. Sol.	Gms. Li_2CO_3 per liter Sat. Sol.	
	0°	25°		0°	25°
0.0	15.2	12.6	0.0	15.2	12.6
8.48	10.1	7.95	10.6	14.6	12.0
16.96	6.85	5.35	21.2	14.5	11.8
25.4	4.82	3.33	31.8	14.5	11.7
33.9	3.70	2.40	42.4	14.4	11.6
42.4	2.67	2.03			

Cl

LITHIUM CHLORIDE LiCl

Correction to Volume I, p. 919 "Distribution of LiCl at 30°, Dhar, 1926a"

Last figure in column 5 should be 0.0347 instead of 0.0317

SOLUBILITY OF LITHIUM CHLORIDE IN WATER

(Woskressenskaja and Janatieva, 1937)

The results extend the work of previous authors (Vol. I, p. 912-913) to lower temperatures, and agree fairly well with those results which were obtained at corresponding temperatures.

t°	Saturated Solution		Solid Phase
	Wt. % LiCl	Mole % LiCl	
-2.4	4.0	1.74	Ice
-9.0	8.0	3.56	"
-23.0	14.0	6.46	"
-36.0	18.0	8.52	"
-50.0	21.0	10.14	"
-62.0	24.0	11.84	"
-66.0	24.4	12.05	Ice + $LiCl \cdot 5H_2O$
-63.0	26.4	13.21	$LiCl \cdot 5H_2O$
-60.4	28.2	14.29	"
-58.0	29.6	15.15	"
-57.0	30.4	15.65	$LiCl \cdot 5H_2O$ + $LiCl \cdot 3H_2O$
-54.0	30.5	15.70	$LiCl \cdot 3H_2O$
-48.0	30.8	15.89	"
-31.0	33.4	17.55	"
-19.2	36.4	19.55	"
-15.6	37.2	20.09	$LiCl \cdot 3H_2O$ + $LiCl \cdot 2H_2O$
0	38.85	21.26	$LiCl \cdot 2H_2O$
4.8	40.0	22.05	"
14.0	43.0	24.25	"
14.2	43.86	24.90	"
20.5	45.6	26.24	$LiCl \cdot 2H_2O$ + $LiCl \cdot H_2O$
25.0	45.9	26.47	$LiCl \cdot H_2O$
30.0	46.15	26.67	"

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE - MAGNESIUM CHLORIDE - WATER

(Woskressenskaja and Janatieva, 1937)

The eutectic temperature is -78°, with the solution containing 23.6% LiCl, 3.6% $MgCl_2$, and the saturating phases Ice + $LiCl \cdot 5H_2O$ + Double Salt (composition not determined). The results are also expressed on molar bases.

Gms. LiCl per 100 gms. Sat. Sol.	Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Solid Phase
	Results at -50°	
31.0	0.0	$LiCl \cdot 3H_2O$
29.5	2.0	"
28.4	4.0	$LiCl \cdot 3H_2O$ + D.S.
25.4	6.6	D.S.
23.6	8.6	D.S. + $MgCl_2 \cdot 12H_2O$
22.6	8.4	$MgCl_2 \cdot 12H_2O$
15.6	7.8	$MgCl_2 \cdot 12H_2O$ + Ice
17.6	6.6	Ice
18.6	4.8	"
20.4	1.4	"
21.0	0.0	"
	Results at -30°	
34.4	0.0	$LiCl \cdot 3H_2O$
33.0	2.2	"
32.0	4.0	$LiCl \cdot 3H_2O$ + D.S.
28.6	7.4	D.S.
27.0	10.4	D.S. + $MgCl_2 \cdot 6H_2O$
21.0	12.8	$MgCl_2 \cdot 6H_2O$
16.4	15.4	$MgCl_2 \cdot 6H_2O$ + $MgCl_2 \cdot 8H_2O$
4.4	22.2	$MgCl_2 \cdot 8H_2O$
3.4	22.8	$MgCl_2 \cdot 8H_2O$ + $MgCl_2 \cdot 12H_2O$
0.0	21.6	$MgCl_2 \cdot 12H_2O$
0.0	19.4	Ice
7.0	11.6	"
11.0	6.8	"
16.0	0.0	"
	Results at -10°	
8.8	0.0	Ice
6.4	4.0	"
4.0	7.0	"
0.0	11.6	"

1:1:7 = $LiCl \cdot MgCl_2 \cdot 6H_2O$

D.S. = Double Salt of Undetermined Composition

* - Extrapolated Value

Gms. LiCl per 100 gms. Sat. Sol.	Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 0°	
38.8	0.0	$LiCl \cdot 2H_2O$
38.2	2.6	"
38.0	4.8	$LiCl \cdot 2H_2O$ + 1:1:7
32.5	8.6	1:1:7
29.6	11.0	"
28.0	12.4	1:1:7 + $MgCl_2 \cdot 6H_2O$
23.0	14.2	$MgCl_2 \cdot 6H_2O$
18.6	17.0	"
13.2	21.6	"
5.4	28.6	"
0.0	35.0	"
	Results at 25°	
45.65	0.0	$LiCl \cdot H_2O$
43.1	2.68	"
40.0	5.74	$LiCl \cdot H_2O$ + 1:1:7
40.2	5.68	"
38.0	6.99	1:1:7
37.1	7.42	"
35.4	8.32	"
33.9	9.34	"
29.3	13.7	"
*28.8	14.2	1:1:7 + $MgCl_2 \cdot 6H_2O$
28.0	14.3	$MgCl_2 \cdot 6H_2O$
22.0	18.0	"
18.9	20.0	"
8.4	28.3	"
0.0	35.4	
	Results at 30°	
46.2	0.0	$LiCl \cdot H_2O$
39.9	6.27	$LiCl \cdot H_2O$ + 1:1:7
39.0	6.81	1:1:7
35.4	8.84	"
35.3	9.14	"
34.1	9.93	"
33.2	10.6	"
31.7	10.7	"
29.3	13.5	"
26.6	15.7	"
*26.6	16.6	1:1:7 + $MgCl_2 \cdot 6H_2O$
25.7	16.5	$MgCl_2 \cdot 6H_2O$
24.8	16.8	"
17.1	21.7	"
10.1	27.3	"
0.0	35.6	"

Data of Woskressenskaja and Janatieva (Con.)

Gms. LiCl per 100 gms. Sat. Sol.	Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Solid Phase	Gms. LiCl per 100 gms. Sat. Sol.	Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Solid Phase
Results at 70°			Results at 102°		
51.2	0.0	$LiCl \cdot H_2O$	56.9	0.0	LiCl
46.5	4.58	"	30.4	23.4	"
39.4	11.2	"	29.2	23.9	"
38.2	12.3	$LiCl \cdot H_2O$ + 1:1:7	22.5	29.7	"
37.3	13.9	1:1:7	19.2	34.1	"
36.1	14.5	"	17.4	35.6	$LiCl + MgCl_2 \cdot 6H_2O$
26.4	20.4	"	13	39	$MgCl_2 \cdot 6H_2O$
22.3	23.5	"	9	41	"
21.6	24.1	"			
20.5	24.4	"	1:1:7 = $LiCl \cdot MgCl_2 \cdot 6H_2O$		
*20.0	26.4	1:1:7 + $MgCl_2 \cdot 6H_2O$			
19.0	26.1	$MgCl_2 \cdot 6H_2O$	D.S. = Double Salt of Undetermined Composition		
18.8	26.3	"			
15.3	27.9	"			
10.2	31.2	"	* = Extrapolated Value		
0.0	38.7	"			

Cl 100 gms. of a saturated solution of lithium chloride in liquid SO_2 contain 0.00062 gms. LiCl at 25°.

SOLUBILITY OF LITHIUM CHLORIDE IN n-PROPYL ALCOHOL SOLUTIONS

(Slavjanski, 1944)

The author determined the freezing points of various solutions containing lithium chloride, n-propyl alcohol, and water, and also reports several refractive indices.

Freezing t°	LiCl		n-Propyl Alcohol	
	Wt. %	Mole %	Wt. %	Mole %
-13.6	5.51	2.70	14.46	5.0
-18.31	4.75	2.55	26.30	10.0
-19.30	4.11	2.41	36.18	15.0
-20.85	3.57	2.23	44.54	20.0
-19.55	3.31	2.13	51.30	25.0
-21.00	2.15	1.97	57.92	30.0
-28.78	10.10	5.26	18.02	5.0
-30.90	9.15	5.06	25.72	10.0
-50.78	7.96	4.76	35.32	15.0
-45.01	15.88	8.29	13.60	5.0
-51.2	13.79	8.15	24.96	10.0
-58.4	22.85	11.24	0.0	0.0
-70.9	20.97	10.81	8.22	3.0
-72.5	19.68	10.51	13.22	5.0

EQUILIBRIUM IN THE SYSTEM LITHIUM CHLORIDE - DIOXANE - WATER AT 25°

(Lynch, 1942)

The refractive index was used to determine the % Dioxane in the solutions.

Gms. per 100 gms. Sat. Sol.		Solid Phase	Region of two Immiscible Liquids			
			Lighter Layer Wt. %		Heavier Layer Wt. %	
LiCl	Dioxane		LiCl	Dioxane	LiCl	Dioxane
45.2	1.4	$LiCl \cdot H_2O$	*0.00	99.9	19.9	46.1
44.5	3.9	"	.00	99.9	18.9	45.5
44.3	4.6	$LiCl \cdot H_2O$ + 1:1:1	.02	99.4	16.9	44.0
37.4	10.6	1:1:1	.06	99.3	12.1	46.6
34.3	13.9	"	.20	91.5	4.92	57.9
30.8	19.6	"	.42	88.6	2.77	67.3
24.1	35.3	"				
20.9	43.7					

* = Two liquid layers in equilibrium with 1:1:1 solid compound.

1:1:1 = $LiCl \cdot H_2O \cdot (C_2H_4)_2O_2$

Cl

SOLUBILITY OF LITHIUM CHLORIDE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent :	Ethylenediamine	Monoethanolamine	Ethylene Glycol
Gms. LiCl per 100 gms. Solvent :	1.39	Approx. 30	14.3

Melting point data for the systems LiCl + $LiNO_3$, LiCl + $NaNO_3$, LiCl + NaCl and LiCl + $NaNO_3 \rightleftharpoons$ NaCl + $LiNO_3$ are given by Blidin, 1940.

Melting points in the system LiCl + $LiVO_3$ are given by Schmitz-Dumont and Schmitz (1944).

The reactions below the melting points in each of the following systems were studied by Link and Wood (1940) by means of X-rays.

LiCl + NaBr	LiCl + NaI	LiCl + NaF
LiCl + KBr	LiCl + KI	LiCl + KF
LiCl + CsBr	LiCl + RbI	LiCl + RbF
LiCl + RbBr	LiCl + CsI	LiCl + CsF

CrO LITHIUM DICHROMATE $Li_2Cr_2O_7$

SOLUBILITY OF LITHIUM DICHROMATE IN WATER

(Hartford and Laue, 1948)

t°	Gms. $Li_2Cr_2O_7 \cdot 2H_2O$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $Li_2Cr_2O_7 \cdot 2H_2O$ per 100 gms. Sat. Sol.	Solid Phase
-6.2	20.14	Ice	0.8	62.36	$Li_2Cr_2O_7 \cdot 2H_2O$
-12.0	29.97	"	*30.0	65.11	"
-17.2	34.82	"	40.0	66.08	"
-24.0	41.10	"	50.0	67.28	"
-35.4	47.39	"	60.0	68.39	"
-49.8	52.32	"	70.0	69.49	"
Approx.-70	56.5	Ice + $Li_2Cr_2O_7 \cdot 2H_2O$	80.0	70.76	"
			90.0	72.26	"
			100.0	73.55	"

The densities of the solutions at 30° were also determined.

* Density = 1.567 (by extrapolation)

F LITHIUM FLUORIDE LiF

Melting point data are given for the following systems:

LiF + $LiVO_3$	(Schmitz-Dumont and Schmitz, 1944)
LiF + YF_3	(Dergunov, 1948)
LiF + NaF	(Bergman and Dergunov, 1941, 1941a)
LiF + MgF_2	(Bergman and Dergunov, 1941)
LiF + MgF_2 + NaF	(Bergman and Dergunov, 1941)

Reactions below the melting points in each of the following systems were studied by Link and Wood, 1940 by means of X-rays.

LiF + NaCl	LiF + NaBr	LiF + NaI
LiF + KCl	LiF + KBr	LiF + KI
LiF + RbCl	LiF + RbBr	LiF + RbI
LiF + CsCl	LiF + CsBr	LiF + CsI

I LITHIUM IODIDE LiI

EQUILIBRIUM IN THE SYSTEM LITHIUM IODIDE - LEAD IODIDE - WATER

(Roger, 1944)

The author studied the system at 0°, 25°, 50°, and 60°, but presents tables of data only for 25°. The 0° isotherm is discussed and a diagram drawn, but at 50° and 60° it is simply stated that "The curves have the same form as at 0° and 25°". The refractive indices were also determined.

Gms. per 100 gms. Sat. Sol. PbI_2	Gms. per 100 gms. Sat. Sol. LiI	Density d_4^{25}	Solid Phase
		Results at 0°	
0.041	0.0	-	PbI_2
0	4	-	"
6	30	-	"
30.52	37.83	-	PbI_2 + $LiI \cdot PbI_2 \cdot 4H_2O$
20.24	48.41	-	$LiI \cdot PbI_2 \cdot 4H_2O$ + $LiI \cdot 3H_2O$
0.0	59.54	-	$LiI \cdot 3H_2O$
		Results at 25°	
0.077	0.0	-	PbI_2
.027	.110	-	"
.009	.313	-	"
.004	.427	-	"
.0019	.850	-	"
.0009	3.32	-	"
.0024	5.26	-	"
.0062	6.51	1.041	"
.067	10.62	1.074	"
.53	20.95	1.182	"
.80	24.11	1.220	"
.84	24.70	1.226	"
2.83	28.84	1.301	"
5.18	31.12	1.355	"
7.92	32.10	1.421	"
11.22	33.64	1.504	"
12.54	33.67	1.522	"
14.09	35.21	1.597	"
18.17	35.68	1.695	"
21.09	36.25	1.778	"
22.36	36.69	1.838	"
26.01	38.08	1.986	"
30.17	38.51	2.132	"
31.91	38.53	2.192	PbI_2 + $PbI_2 \cdot LiI \cdot 4H_2O$
31.18	39.25	2.184	$PbI_2 \cdot LiI \cdot 4H_2O$
28.71	40.53	2.159	"
27.26	42.16	2.150	"
26.67	42.44	2.147	"
25.41	43.90	2.145	"
24.09	44.91	2.137	"
23.69	45.33	2.136	"
23.05	46.24	2.140	"
22.45	46.40	2.140	"
22.27	47.70	2.141	"
21.91	48.19	2.146	"
21.18	49.79	2.165	$PbI_2 \cdot LiI \cdot 4H_2O$ + $LiI \cdot 3H_2O$
20.88	49.84	2.158	$LiI \cdot 3H_2O$
20.58	49.96	2.152	"
15.81	52.69	2.078	"
13.65	54.25	2.041	"
9.73	56.19	1.967	"
4.39	59.42	1.882	"
1.79	60.51	1.843	"
0.0	61.90	1.825	"

I The reactions below the melting points in each of the following systems were studied by Link and Wood (1940) by means of X-rays.

LiI + NaCl	LiI + NaBr	LiI + NaF
LiI + KCl	LiI + KaBr	LiI + KF
LiI + RbCl	LiI + RbBr	LiI + CsF
LiI + CsCl	LiI + CsBr	LiI + RbF

NO LITHIUM NITRATE $LiNO_3$

EQUILIBRIUM IN THE SYSTEM LITHIUM NITRATE - AMMONIUM NITRATE - WATER
(Campbell, 1942)

Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Gms. $LiNO_3$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 90°	
88.5	0.0	NH_4NO_3 II
70.0	10.6	"
66.7	20.8	"
66.0	23.3	"
65.5	29.3	NH_4NO_3 II + $LiNO_3$
60.7	32.0	$LiNO_3$
56.3	34.6	"
52.2	36.9	"
45.0	41.5	"
38.5	45.0	"
38.0	45.5	"
26.5	52.2	"
23.2	54.2	"
17.6	57.8	"
10.1	61.8	"
0.0	68.0	"
	Results at 31°	
71.5	0.0	NH_4NO_3 IV
70.0	0.6	"
68.2	1.6	"
66.2	2.9	"
60.5	7.7	"
56.5	11.4	"
47.3	22.9	"
43.8	32.9	"
42.3	34.5	"
42.0	38.6	NH_4NO_3 IV + $LiNO_3$
39.9	39.3	$LiNO_3$
39.3	39.9	"
38.4	40.5	"
37.7	41.1	"
32.2	43.0	"
31.5	43.5	"
24.0	47.0	"
14.8	51.8	"
9.1	53.9	"
5.1	56.0	"
3.1	56.7	"
1.5	57.7	"
0.0	58.5	"

Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Gms. $LiNO_3$ per 100 gms. Sat. Sol.	Solid Phase
	Results at 60°	
81.0	0.0	NH_4NO_3 III
68.5	9.2	"
63.0	14.9	"
60.2	18.7	"
57.0	25.9	"
57.1	27.4	"
56.4	31.2	NH_4NO_3 III + $LiNO_3$
56.9	31.5	$LiNO_3$
32.2	44.3	"
30.2	45.5	"
19.2	51.5	"
14.4	54.0	"
9.0	56.6	"
0.0	62.0	"
	Results at 25°	
69.2	0.0	NH_4NO_3 IV
55.8	9.9	"
49.1	17.4	"
43.6	25.7	"
40.2	31.5	"
38.5	35.0	"
37.6	39.0	NH_4NO_3 IV + $LiNO_3$
36.9	39.5	$LiNO_3$
33.8	41.0	"
32.2	41.8	"
29.0	43.3	"
20.8	47.3	"
19.6	48.0	"
14.3	50.5	"
14.0	51.0	$LiNO_3$ + $LiNO_3 \cdot 3H_2O$
12.5	49.0	$LiNO_3 \cdot 3H_2O$
11.5	47.5	"
7.0	45.0	"
3.8	45.0	"
2.8	45.3	"
1.0	45.6	"
0.0	46.0	"

0.5 gms. $LiNO_3$ dissolve in 100 gms. of anhydrous HNO_3 (Temp. not given) (Jander and Wendt, 1948). NO

Melting points have been determined for the following systems:

$LiNO_3$ + $NaNO_3$	(Blindin, 1940)(Campbell and Campbell, 1947)
$LiNO_3$ + NH_4NO_3	(Campbell, 1940, 1942)(Perman and Harrison, 1924)
$LiNO_3$ + NaCl	(Blidin , 1940)
$LiNO_3$ + $NaNO_3$ + NH_4NO_3	(Campbell and Campbell, 1947)
$LiNO_3$ + $N_2H_4 \cdot HNO_3$	(Barlot and Marsaule, 1948)
$LiNO_3$ + Guanidine Nitrate	(Clark and Esterbrook, 1949)

LITHIUM OXIDE Li_2O O

X-ray examination of the system Li_2O + SiO_2 indicated the presence of 2:1, 1:1, and 1:2 compounds. (Austin, 1947).

LITHIUM PERRHENATE $LiReO_4$ ReO

SOLUBILITY OF LITHIUM PERRHENATE IN WATER
(Smith and Long, 1948)

t°	Moles $LiReO_4$ per 100 gms. H_2O	Solid Phase
0	1.00	$LiReO_4 \cdot 2H_2O$
30	1.40	"
50.3	1.40	"

LITHIUM SULFATE Li_2SO_4 SO

SOLUBILITY OF LITHIUM SULFATE IN WATER
(Campbell, 1948)

No evidence of $Li_2SO_4 \cdot 2H_2O$, reported by Friend (Vol. I, p. 932), was found.

t°	Gms. Li_2SO_4 per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. Li_2SO_4 per 100 gms. Sat. Sol.	Solid Phase
-1.735	4.072	Ice	-21.4	27.1	Ice
-3.30	7.791	"	-23.0	27.9	Ice + $Li_2SO_4 \cdot H_2O$
-5.11	11.30	"	142.5	22.65	$Li_2SO_4 \cdot H_2O$
-7.04	14.33	"	186	22.7	"
-9.67	17.67	"	214	23.0	"
-14.65	21.95	"	232.8	~23	$Li_2SO_4 \cdot H_2O$ + Li_2SO_4
-18.45	24.85	"			

The vapor pressures of saturated solutions from 60° to 227° are also given.

SO SOLUBILITY OF LITHIUM SULFATE IN LITHIUM CHLORIDE SOLUTIONS AT -12.25°

(Campbell, 1948)

The author did not find the dihydrate indicated by Friend (Vol. I, p. 932).

Saturated Solution Wt. %		Wet Residue Wt. %		Solid Phase
Li_2SO_4	LiCl	Li_2SO_4	LiCl	
22.00	3.16	66.91	1.03	$Li_2SO_4 \cdot H_2O$
16.02	7.10	64.63	2.25	"
6.18	14.60	64.84	3.92	"
0.38	25.03	71.81	8.65	$Li_2SO_4 \cdot H_2O + LiCl \cdot 2H_2O$

Mg MAGNESIUM Mg

Equilibrium in the system $Mg + PbCl_2 \rightleftharpoons Pb + MgCl_2$ at 800° was studied by Ruff and Busch, 1925.

BO MAGNESIUM BORATE

EQUILIBRIUM IN THE SYSTEM MAGNESIUM OXIDE - BORIC OXIDE - WATER AT 25°

(Nikolaev and Chelishcheva, 1940)

Gms. B_2O_3 per 100 gms. Sat. Sol.	Gms. MgO per 100 gms. Sat. Sol.	Solid Phase	Gms. B_2O_3 per 100 gms. Sat. Sol.	Gms. MgO per 100 gms. Sat. Sol.	Solid Phase
0.0	0.004	$Mg(OH)_2$	2.87	0.210	Diborate + Triborate
0.215	.100	$Mg(OH)_2$ + Inderite	2.98	.211	Triborate
.573	.060	Inderite	4.76	.271	Triborate + H_3BO_3
1.47	.119	Inderite + Diborate	3.17	0.0	H_3BO_3
2.72	.206	Diborate			

Inderite = $2MgO \cdot 3B_2O_3 \cdot 15H_2O$

Diborate = $MgO \cdot 2B_2O_3 \cdot 9H_2O$

Triborate = $MgO \cdot 3B_2O_3 \cdot 7.5H_2O$

Br MAGNESIUM BROMIDE $MgBr_2$

EQUILIBRIUM IN THE SYSTEM MAGNESIUM BROMIDE - RUBIDIUM BROMIDE - WATER AT 25°

(Blidin, 1947a)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
MgBr	RbBr		MgBr	RbBr	
0.0	53.35	RbBr	40.31	9.6	RbBr
10.10	41.51	"	50.40	Trace	$RbBr + MgBr_2 \cdot 6H_2O$
20.50	28.20	"	50.38	0.0	$MgBr_2 \cdot 6H_2O$
30.40	17.0	"			

EQUILIBRIUM IN THE SYSTEM MAGNESIUM BROMIDE - n-BUTYL MAGNESIUM BROMIDE - ETHER AT 25°

(Doering and Noller, 1939)

The authors studied the solubilities of the dietherates of the two salts in ether solutions and found a large area of complete miscibility. The results are in Wt. % .

Lower Layer		Upper Layer	
$C_4H_9MgBr \cdot 2(C_2H_5)_2O$	$MgBr \cdot 2(C_2H_5)_2O$	$C_4H_9MgBr \cdot 2(C_2H_5)_2O$	$MgBr \cdot 2(C_2H_5)_2O$
0.2	72.5	-	-
2.3	73.3	-	-
6.1	70.4	0.8	5.5
8.4	67.7	1.4	5.8
13.9	60.7	2.9	5.9
16.1	57.9	3.6	5.8
23.1	39.2	10.3	10.9
22.3	31.4	14.4	15.3

Data for the system $MgBr_2 - (C_2H_5)_2O - H_2O$ at 25° are given by Rowley and Bartz, 1941.

MAGNESIUM 2, 4 - DINITROPHENATE $[C_6H_3(OH)(NO_2)_2]_2Mg$ CH

MAGNESIUM 2, 4 - DINITROCRESYLATE $[C_6H_2(CH_3)(OH)(NO_2)_2]_2Mg$

See note p. 66 .

The solubility of each compound is about 3% in water at room temperature. (Pastac and Lecrivain, 1948).

MAGNESIUM ANTHRACENE SULFONATES $C_{14}H_8S_2O_6Mg$ CH
$(C_{14}H_9SO_3)_2Mg$

SOLUBILITY IN WATER

(Federov and Lodygin, 1942)

Salt	Gms. Salt per 100 gms. Sat. Sol.		Salt	Gms. Salt per 100 gms. Sat. Sol.	
	20°	100°		20°	100°
α-$Mg(C_{14}H_9SO_3)_2 \cdot 4H_2O$	0.0784	0.2528	1, 8-$C_{14}H_8S_2O_6Mg \cdot 3H_2O$	2.0383	9.0043
β-$Mg(C_{14}H_9SO_3)_2 \cdot 4H_2O$	.0077	.1213	2, 6-$C_{14}H_8S_2O_6Mg \cdot 4H_2O$	0.1196	0.3022
1, 5-$C_{14}H_8S_2O_6Mg \cdot 3H_2O$	.1472	.3077	2, 7-$C_{14}H_8S_2O_6Mg \cdot 2H_2O$	0.0661	0.2369

MAGNESIUM CARBONATE $MgCO_3$ CO

SOLUBILITY OF MAGNESIUM CARBONATE IN SODIUM CARBONATE SOLUTIONS AND VICE VERSA AT 35°

(Oboukhov and Gordon, 1935)

The authors also present data to show the existence of the compound $MgCO_3 \cdot Na_2CO_3$ in solutions containing about 33% Na_2CO_3.

Gms. $MgCO_3$ per 100 gms. Sat. Sol.	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Solid Phase	Gms. $MgCO_3$ per 100 gms. Sat. Sol.	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Solid Phase
0.074	0.0	$MgCO_3$	0.498	20.25	$MgCO_3$
.056	1.00	"	.508	22.81	"
.100	2.89	"	.516	26.14	"
.146	4.75	"	.546	28.40	"
.285	8.82	"	.531	31.12	"
.308	12.78	"	.698	33.50	"
.386	16.39	"	.830	33.53	$MgCO_3 + Na_2CO_3$

CO Basic MAGNESIUM CARBONATE $3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O$

100 gms. of a saturated solution in furfural contain 0.01 gms. $3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O$ at 25°. (Trimble, 1941)

Cl MAGNESIUM CHLORIDE $MgCl_2$

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE - MAGNESIUM SULFATE - WATER

(Kusnetzow, 1937)

A diagram is given showing the solid phases present in equilibrium with solutions from -40° to 120°. The results below are also given in moles per 1000 moles of water.

Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. $MgSO_4$ per 100 gms. Sat. Sol.	Density $d_4^{t°}$	Solid Phase
		Results at 25°	
26.06	4.92	1.2966	$MgSO_4 \cdot 7H_2O + MgSO_4 \cdot 6H_2O$
29.89	3.93	1.3239	$MgSO_4 \cdot 6H_2O + MgSO_4 \cdot 5H_2O$
32.09	3.06	1.3398	$MgSO_4 \cdot 5H_2O + MgSO_4 \cdot 4H_2O$
34.36	2.13	1.3545	$MgSO_4 \cdot 4H_2O + MgSO_4 \cdot 6H_2O$
		Results at 35°	
0.0	29.32	1.3399	$MgSO_4 \cdot 7H_2O$
5.70	22.21	1.3000	"
12.55	14.93	-	"
19.22	9.79	1.2846	"
19.54	9.62	-	$MgSO_4 \cdot 7H_2O + MgSO_4 \cdot 6H_2O$
19.56	9.54	1.2872	$MgSO_4 \cdot 6H_2O$
20.79	8.97	1.2896	"
21.95	8.14	1.2889	"
24.72	6.56	-	"
25.33	6.45	1.3104	"
25.61	6.44	1.3122	$MgSO_4 \cdot 6H_2O + MgSO_4 \cdot 5H_2O$
25.61	6.44	1.3122	$MgSO_4 \cdot 5.5\ H_2O$
25.71	6.26	-	$MgSO_4 \cdot 5H_2O$
*26.14	6.08	-	$MgSO_4 \cdot 6H_2O$
*26.14	6.08	-	"
*26.82	5.77		$MgSO_4 \cdot 6H_2O + MgSO_4 \cdot 5H_2O$

* = Metastable

Gms. $MgCl_2$ per 100 gms. Sat. Sol.	Gms. $MgSO_4$ per 100 gms. Sat. Sol.	Density $t°_4°$	Solid Phase
		Results at 35° (Con.)	
*27.01	5.84	-	$MgSO_4 \cdot 5.5H_2O$
30.28	5.33	-	$MgSO_4 \cdot 5H_2O$
30.21	4.47	-	$MgSO_4 \cdot 4.2H_2O$
30.58	3.88	-	$MgSO_4 \cdot 4H_2O$
30.58	3.88	-	$MgSO_4 \cdot 3.77H_2O$
31.56	3.49	-	$MgSO_4 \cdot 3.85H_2O$
35.09	2.82	-	$MgSO_4 \cdot 4H_2O + MgCl_2 \cdot 6H_2O$
35.09	2.82	-	$MgSO_4 \cdot 3.77H_2O$
34.79	2.58	-	$MgSO_4 \cdot 3.9H_2O$
35.20	1.72	1.3570	$MgSO_4 \cdot H_2O + MgCl_2 \cdot 6H_2O$
36.14	0.0	1.3363	$MgCl_2 \cdot 6H_2O$

* = Metastable

The quaternary system $MgCl_2 + Na_2SO_4 \rightleftharpoons 2NaCl + MgSO_4$ in water was studied from -14° to +25° by Druzhinin, Nikolaev, et al (1949); at 25° by Levina (1938) (chiefly the metastable extensions of the various fields of saturation); and at 55° by Yanat'eva, 1948, (below). Cl

The eutectic of the system $MgCl_2 + NaCl + H_2O$ is at -35°, 1.56% NaCl, 22.71% $MgCl_2$ with solid phases: Ice + $NaCl \cdot 2H_2O$ + $MgCl_2 \cdot 12H_2O$. The invariant solution in equilibrium with $MgCl_2 \cdot 12H_2O$ + $NaCl \cdot 2H_2O$ + NaCl (-26°) contains 1.81% NaCl and 23.35% $MgCl_2$. - Luzhnaja and Vereshtchetina, 1946.

Data for the system $MgCl_2$ - NaCl - H_2O up to 200° is given by d'Ans and Sypiena, 1942.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE, MAGNESIUM SULFATE, SODIUM CHLORIDE, SODIUM SULFATE - WATER AT 55°

(Yanatieva, 1948)

Gms. per 100 gms. Sat. Sol.				Density	Solid Phase
NaCl	Na_2SO_4	$MgCl_2$	$MgSO_4$		
-	-	-	34.40	-	$MgSO_4 \cdot 6H_2O$
-	5.37	-	33.66	1.4396	$MgSO_4 \cdot 6H_2O$ + Astrakanite
-	23.49	-	12.93	1.4038	Astrakanite + Na_2SO_4
-	31.56	-	-	-	Na_2SO_4
24.36	5.16	-	-	1.2344	Na_2SO_4 + NaCl
26.92	-	-	-	-	NaCl
2.76	-	36.56	-	-	NaCl + $MgCl_2 \cdot 6H_2O$
-	-	37.60	-	-	$MgCl_2 \cdot 6H_2O$
-	-	37.33	0.44	1.3592	$MgCl_2 \cdot 6H_2O$ + $MgSO_4 \cdot H_2O$
-	-	14.90	18.09	1.3503	$MgSO_4 \cdot H_2O$ + $MgSO_4 \cdot 6H_2O$
5.61	17.05	-	12.18	-	$MgSO_4$ + Astrakanite
9.28	12.82	-	10.89	1.3265	Na_2SO_4 + Astrakanite + Vanthoffite
12.60	8.82	-	10.09	-	Na_2SO_4 + Vanthoffite
13.69	8.16	-	9.42	-	"
17.74	3.39	-	9.95	-	"
21.60	-	1.14	7.97	1.2658	Na_2SO_4 + Vanthoffite + NaCl
23.89	2.07	-	4.21	-	Na_2SO_4 + NaCl
24.04	2.72	-	3.17	-	Na_2SO_4 "

Data of Yanatieva, 1948 (Con.)

Gms. per 100 gms. Sat. Sol.				Density	Solid Phase
NaCl	Na_2SO_4	$MgCl_2$	$MgSO_4$		
20.21	-	2.51	7.82	-	NaCl + Vanthoffite
17.59	-	4.97	7.63	1.2906	NaCl + Vanthoffite + Astrakanite
16.64	2.16	-	12.42	-	Astrakanite + Vanthoffite
11.94	8.99	-	11.39	-	"
16.41	-	6.35	7.69	-	Astrakanite + NaCl
12.86	-	9.74	7.87	-	"
9.43	-	12.92	7.62	-	"
8.90	-	13.64	8.24	1.3141	Astrakanite + Löweite + NaCl
6.07	-	10.60	16.32	-	Astrakanite + Löweite
3.91	-	8.54	22.42	-	"
3.73	-	7.51	23.73	-	"
3.16	-	7.32	24.95	1.3825	Astrakanite + Löweite + $MgSO_4 \cdot 6H_2O$
4.12	-	5.21	26.73	-	Astrakanite + $MgSO_4 \cdot 6H_2O$
Cl 4.02	-	0.35	33.51	-	"
2.10	-	10.80	21.65	1.3510	$MgSO_4 \cdot 6H_2O$ + Löweite
1.37	-	13.24	19.95	-	"
1.14	-	14.36	19.02	1.3369	$MgSO_4 \cdot 6H_2O$ + Löweite + $MgSO_4 \cdot H_2O$
1.77	-	15.47	17.15	-	$MgSO_4 \cdot H_2O$ + Löweite
1.50	-	17.70	15.00	-	"
1.55	-	18.41	14.41	-	"
2.16	-	24.24	7.38	1.3165	$MgSO_4 \cdot H_2O$ + Löweite + NaCl
1.20	-	32.74	2.81	-	$MgSO_4 \cdot H_2O$ + NaCl
0.30	-	37.52	0.40	1.3625	$MgSO_4 \cdot H_2O$ + NaCl + $MgCl_2 \cdot 6H_2O$

A diagram for the system Mg^{++}, $Na^+//Cl^-$, $SO_4^=$ in water from -20° to +25° is given by Feigelson and Bergman, 1940.

The distribution of micro amounts of Br^- between the solution and solid phase during isothermal evaporation in the system $MgCl_2 - H_2O$ at 25° was studied by Cirkov, 1944.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHLORIDE - MAGNESIUM MOLYBDATE - WATER AT 25°

(Ricci and Linke, 1951)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
$MgMoO_4$	$MgCl_2$			$MgMoO_4$	$MgCl_2$		
15.90	0.0	1.159	M5	0.58	26.83	1.235	M5 + M2
12.84	2.03	1.143	M5	.63	27.52	1.234	M2
10.07	4.29	1.128	M5	.52	28.03	-	M2
7.14	7.54	1.131	M5	.39	29.29	1.258	M2
4.06	11.58	1.141	M5	.31	30.37	-	M2
2.75	15.36	1.156	M5	.30	31.25	1.278	M2
1.55	19.30	1.179	M5	.26	32.29	1.293	M2
0.91	24.20	1.216	M5	.12	33.34	1.279	M2
.83	24.25	-	M5	.10	34.53	1.312	M2
.78	25.63	1.231	M5	.15	35.53	1.324	M2 + C16
.67	26.34	1.229	M5	0.0	35.71	1.323	C16

M5 = $MgMoO_4 \cdot 5H_2O$ M2 = $MgMoO_4 \cdot 2H_2O$ C16 = $MgCl_2 \cdot 6H_2O$

For data on the solubility of $MgCl_2$ in KNO_3 and KCl solutions see p. 308.

EQUILIBRIUM IN THE SALT PAIR $MgCl_2 + Na_2S_2O_3 \rightleftharpoons MgS_2O_3 + 2NaCl + H_2O$ AT 25°
(Silberman and Ivanov, 1946)

Saturated Solution Wt. %				Solid Phase
MgS_2O_3	$Na_2S_2O_3$	$MgCl_2$	NaCl	
-	32.98	-	9.86	$Na_2S_2O_3 \cdot 5H_2O + NaCl$
-	-	35.80	0.21	$MgCl_2 \cdot 6H_2O + NaCl$
3.10	-	33.68	-	$MgCl_2 \cdot 6H_2O + MgS_2O_3 \cdot 6H_2O$
19.18	25.48	-	-	$Na_2S_2O_3 \cdot 5H_2O + MgS_2O_3 \cdot 6H_2O$
15.25	22.13	-	6.45	$Na_2S_2O_3 \cdot 5H_2O + NaCl$
18.56	20.49	-	5.64	$Na_2S_2O_3 \cdot 5H_2O + NaCl + MgS_2O_3 \cdot 6H_2O$
23.05	9.14	-	8.67	$MgS_2O_3 \cdot 6H_2O + NaCl$
19.63	-	8.34	6.38	"
17.88	-	10.56	5.36	"
10.15	-	20.40	1.99	"
3.17	-	33.40	0.36	$MgS_2O_3 \cdot 6H_2O + MgCl_2 \cdot 6H_2O + NaCl$

C1

100 gms. of a saturated solution in furfural contain 0.04 gms. $MgCl_2 \cdot 6H_2O$ at 25°. (Trimble, 1941).

100 cc of a saturated solution of $MgCl_2$ in a mixture of equal volumes of ethyl ether and water, saturated with HCl at 0°, contain 0.0122 gms. of $MgCl_2$. (Fischer and Seidel, 1941)

21.57 gms. of $MgCl_2$ are dissolved in 100 gms. of a saturated solution in water containing 0.043 gms. of BrC_2H_4Br at 35°. (Druzhinin and Shostakovsky, 1942).

Melting points are given for the following:

$MgCl_2 + NaCl$	(Klemm and Weiss, 1940)
	(Beyersdorver and Oryschkewitsch, 1948)
	(Sveranskaya, 1938)
$MgCl_2 + MgSO_4$	(" ")
$MgCl_2 + Na_2SO_4 \rightleftharpoons MgSO_4 + NaCl$	(" ")
$MgCl_2 + K_2SO_4 \rightleftharpoons MgSO_4 + KCl$	(" ")
$MgCl_2 + KCl$	(Berersdorfer and Oryschkewitsch, 1948)
$MgCl_2 + RbCl$	(" " " ")

The phase diagrams of the systems $MgCl_2 + NaCl$, $MgCl_2 + KCl$, and $MgCl_2 + RbCl$ were determined by Klemm, 1948.

The specific volumes and heat capacities of solutions of Magnesium Chloride and ammonium nitrate in water are given by Rutskov, 1948.

MAGNESIUM PERCHLORATE $Mg(ClO_4)_2$

C10

SOLUBILITY OF ANHYDROUS MAGNESIUM PERCHLORATE IN ETHYL ETHER
(Rowley and Seiler, 1946)

t°	Gms. $Mg(ClO_4)_2$ per 100 gms. $(C_2H_5)_2O$
0	0.0437
15	0.0588
25	0.0643

CrO MAGNESIUM CHROMATE $MgCrO_4$

SOLUBILITY OF MAGNESIUM CHROMATE IN WATER

(Hill, Soth, and Ricci, 1940a)

Each result is the mean of a determination in which equilibrium was approached from supersaturation, and one in which it was approached from undersaturation. A very finely divided solid phase was produced at 75° upon long stirring, but its composition was not determined, and the pentahydrate may be metastable at this temperature.

t°	Gms. $MgCrO_4$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $MgCrO_4$ per 100 gms. Sat. Sol.	Solid Phase
0	32.06	$MgCrO_4 \cdot 7H_2O$	25	35.39	$MgCrO_4 \cdot 5H_2O$
10	33.87	"	35	35.81	"
15	34.78	"	50	36.82	"
e 17.2	35.15	$MgCrO_4 \cdot 7H_2O + MgCrO_4 \cdot 5H_2O$	60	37.68	"
* 10	34.94	$MgCrO_4 \cdot 5H_2O$	75	39.96	"
* 15	35.20	"			

e = extrapolated * = Metastable

EQUILIBRIUM IN THE SYSTEM MAGNESIUM CHROMATE - AMMONIUM CHROMATE - WATER AT 25°

(Hill, Soth, and Ricci, 1940)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$MgCrO_4$	$(NH_4)_2CrO_4$		$MgCrO_4$	$(NH_4)_2CrO_4$	
0.0	27.02	$(NH_4)_2CrO_4$	11.71	3.39	1:1:6
0.36	27.02	$(NH_4)_2CrO_4$ + 1:1:6	19.21	1.95	"
0.53	22.81	1:1:6	28.81	0.85	"
1.25	14.02	"	35.20	0.41	1:1:6 + $MgCrO_4 \cdot 5H_2O$
4.62	6.64	"	35.39	0.0	$MgCrO_4 \cdot 5H_2O$
6.52	5.31				

1:1:6 = $MgCrO_4 \cdot (NH_4)_2CrO_4 \cdot 6H_2O$

CrO MAGNESIUM Ammonium CHROMATE $MgCrO_4 \cdot (NH_4)_2CrO_4 \cdot 6H_2O$

At 25°, 100 gms. of a saturated solution in water contain 11.50 gms. $MgCrO_4 \cdot (NH_4)_2CrO_4$ (Density = 1.088) (Hill, Soth, and Ricci, 1940).

THE SYSTEMS MAGNESIUM AMMONIUM CHROMATE - MAGNESIUM AMMONIUM SELENATE - WATER AND MAGNESIUM AMMONIUM CHROMATE - MAGNESIUM AMMONIUM SULFATE - WATER AT 25°

(Hill, Soth, and Ricci, 1940)

The salts form continuous, hexahydrated solid solutions. Each determination was made in duplicate, and equilibrium was approached from two directions.

$Mg(NH_4)_2(CrO_4)_2$ - $Mg(NH_4)_2(SeO_4)_2$ - H_2O

Sat. Sol. Wt. %		Solid Wt. %	
A	B	A	B
11.50	0.0	73.00	0.0
8.43	6.07	61.43	12.23
5.63	11.85	45.73	28.70
3.40	16.59	29.31	45.80
2.04	19.37	17.68	57.94
1.09	21.28	9.24	66.78
0.0	23.31	0.0	76.21

$Mg(NH_4)_2(CrO_4)_2$ - $Mg(NH_4)_2(SO_4)_2$ - H_2O

Sat. Sol. Wt. %		Solid Wt. %	
A	C	A	C
11.50	0.0	73.00	0.0
8.83	4.75	61.33	11.20
6.60	8.61	45.95	25.78
5.08	10.89	33.85	37.42
3.05	13.44	17.27	53.40
1.77	14.96	8.90	61.39
0.0	16.58	0.0	70.02

A = $Mg(NH_4)_2(CrO_4)_2$ B = $Mg(NH_4)_2(SeO_4)_2$ C = $Mg(NH_4)_2(SO_4)_2$

MAGNESIUM DICHROMATE $MgCrO_7$ CrO

A saturated solution in water at 25° contains 81.0 gms. $MgCrO_7 \cdot 5H_2O$ per 100 gms. saturated solution (density d_4^{25} = 1.712). Approximately 200 gms. $MgCrO_4 \cdot 5H_2O$ dissolve in one liter of saturated solution in alcohol at 25° (decomposes). Above 89.4° $MgCrO_7 \cdot H_2O$ is the stable phase.

(Hartford, 1946)

MAGNESIUM FLUORIDE MgF_2 F

Melting points have been determined in the following systems:

MgF_2 + NaF (Bergman and Dergunov, 1941, 1945) (Dergunov and Bergman, 1948)

MgF_2 + RbF (Remy and Seeman, 1940) (Dergunov and Bergman, 1948)

MAGNESIUM IODIDE MgI_2 I

Melting points in the systems MgI_2 + KI and MgI_2 + NaI are given by Beyersdorfer and Oryschkewitsch (1948) and by Klemm (1948).

SOLUBILITY OF MAGNESIUM MOLYBDATE IN WATER

(Ricci and Linke, 1951)

t°	Gms. $MgMoO_4$ per 100 gms. Sat. Sol.	Density	Solid Phase	t°	Gms. $MgMoO_4$ per 100 gms. Sat. Sol.	Density	Solid Phase
-0.45	3.94	-	Ice	45	17.74	1.178	5
-0.75	6.28	-	"	50	18.40	1.180	5
-1.25	9.38	-	"	55	19.00	1.185	5
-1.67	11.55*	1.111	Ice + 7	58	19.48	1.184	5
5	12.94	1.127	7	59	19.55	1.192	5
7	13.50	1.135	7	62m	19.90	1.195	5
10	14.31	1.143	7	60.8	19.85*	1.192	5 + 2
11	14.61	1.145	7	60m	19.96	1.196	2
12.7	15.15*	1.151	7 + 5	63	19.12	1.182	2
5m	14.43	1.143	5	64	18.83	1.177	2
10m	14.85	1.147	5	71	16.51	1.149	2
15	15.26	1.151	5	72	16.13	1.147	2
20	15.59	1.150	5	75	15.30	1.141	2
25	15.90	1.159	5	80	13.70	1.121	2
30	16.29	1.161	5	85	12.09	1.096	2
36	16.89	1.160	5	90	10.78	1.087	2
43	17.63	1.160	5	95	9.38	1.072	2

m = metastable 7= $MgMoO_4 \cdot 7H_2O$ 5 = $MgMoO_4 \cdot 5H_2O$ 2 = $MgMoO_4 \cdot 2H_2O$

*Extrapolated

EQUILIBRIUM IN THE SYSTEM MAGNESIUM MOLYBDATE - MAGNESIUM SULFATE - WATER AT 25°

(Ricci and Linke, 1951)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
$MgMoO_4$	$MgSO_4$			$MgMoO_4$	$MgSO_4$		
15.90	0.0	1.159	M	6.42	20.72	1.292	M
14.70	2.91	1.176	M	5.06	23.76	1.313	M + S
13.28	6.06	1.198	M	4.51	24.02	1.305	S
12.08	8.79	1.218	M	3.70	24.65	1.296	S
10.76	11.54	1.230	M	3.20	24.78	1.295	S
9.20	14.64	1.254	M	2.26	25.33	1.291	S
7.63	18.03	1.271	M	0.0	26.67	1.278	S

M = $MgMoO_4 \cdot 5H_2O$ S = $MgSO_4 \cdot 7H_2O$

EQUILIBRIUM IN THE SYSTEM MAGNESIUM MOLYBDATE - SODIUM MOLYBDATE - WATER AT 25°

(Ricci and Linke, 1951)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
$MgMoO_4$	Na_2MoO_4			$MgMoO_4$	Na_2MoO_4		
15.90	0.0	1.159	M	9.27	17.27	1.271	M + D
13.71	4.84	1.177	M	8.57	17.91	1.272	D
12.09	9.14	1.210	M	7.34	19.15	1.267	D
11.22	11.38	1.220	M	6.94	19.85	1.273	D
11.00	12.10	1.230	M	4.23	23.56	1.285	D
10.69	12.99	1.238	M	1.62	29.30	1.321	D
10.39	13.92	1.248	M	1.57	29.44	1.322	D
10.17	14.68	1.252	M	0.48	34.74	1.373	D
10.03	14.86	1.250	M	.39	35.79	1.387	D
9.84	15.29	1.255	M	.23	37.41	1.401	D
9.44	16.45	1.268	M	.10	38.26	1.419	D
9.26	17.18	1.270	M	.11	39.31	1.429	D + N
8.87[m]	18.45	1.282	M	0.0	39.38	1.432	N

m = metastable M = $MgMoO_4 \cdot 5H_2O$ N = $Na_2MoO_4 \cdot 2H_2O$ D = $MgMoO_4 \cdot Na_2MoO_4 \cdot 2H_2O$

INVARIANT POINTS IN THE QUATERNARY SYSTEM MAGNESIUM MOLYBDATE - SODIUM SULFATE - WATER AT 25°

MoO

(Ricci and Linke, 1951)

Data are also given for quaternary solutions saturated with two solid phases.

Moles per mole of Dissolved Salts					Density	Solid Phase
$MgMoO_4$	$MgSO_4$	Na_2SO_4	Na_2MoO_4	H_2O		
			1.0000	17.60	1.432	A
		.3394	.6606	14.67	1.446	A + B
		1.0000		28.70	1.201	B
	.4937	.5063		13.87	1.345	B + F
	.5000	.5000		13.9	1.345	F
	.6766	.3234		13.83	1.349	F + C
	1.0000			18.37	1.278	C
.1222	.8778			17.57	1.313	C + D
1.0000				54.10	1.159	D
.3750			.6250	30.39	1.271	D + E
.0031			.9969	17.56	1.429	E + A
.0037		.3363	.6600	14.69	1.442	A + B + E
.1793	.2529	.5678		15.26	1.358	B + D + E
.1133	.3781	.5086		13.74	1.376	B + D + F
.0759	.6164	.3077		13.63	1.375	C + D + F

A = $Na_2MoO_4 \cdot 2H_2O$
B = $Na_2SO_4 \cdot 10H_2O$
C = $MgSO_4 \cdot 7H_2O$
D = $MgMoO_4 \cdot 5H_2O$
E = $MgMoO_4 \cdot Na_2MoO_4 \cdot 2H_2O$
F = $MgSO_4 \cdot Na_2SO_4 \cdot 4H_2O$

NO MAGNESIUM NITRATE $Mg(NO_3)_2$

100 gms. of a saturated solution in furfural contain 0.03 gms. $Mg(NO_3)_2 \cdot 6H_2O$. (Trimble, 1941)

Melting points in the system $Mg(NO_3)_2$ + $NaNO_3$ are given by Jänecke, 1942.

O MAGNESIUM OXIDE MgO

The system $MgO - SiO_2 - H_2O$ was investigated between 300° and 900°, and a possible phase diagram drawn, by Bowen and Tuttle, 1949.

The following systems have been studied:

MgO + ZnO	at 900°	Rigamonti, 1946
MgO + MnO		Pettersson, 1946; Jay and Andrews, 1944.
MgO + $TlCrO_4$	at 300°	Montignie, 1941
MgO + FeO		Jay and Andrews, 1944; Pettersson, 1946.
MgO + MgS		Mikulinsky and Kamkine, 1938
MgO + V_2O_5	(in the solid state)	Jander and Lorenz, 1941

OH MAGNESIUM HYDROXIDE $Mg(OH)_2$

Oka, 1940 found the solubility of magnesium hydroxide in water to be 1.1×10^{-4} moles per liter by potentiometric titration. Nasanen, 1941 determined the thermodynamic solubility product to be 3.07×10^{-11}.

A comparison of the solubilities of naturally occuring and freshly precipitated $Mg(OH)_2$ was made by Quatarol and Belfiori, 1941. Ageing decreases the solubility of the precipitate.

d'Ans and Katz, 1941 showed that the solubility of $Mg(OH)_2$ increases with increasing $MgCl_2$ in solution.

PO MAGNESIUM PHOSPHATE $MgHPO_4$

The apparent solubility product of $MgHPO_4$ was found by Tabor and Hastings (1943) to be 3.5×10^{-5} at 38° and by Greenwald (1945) to be about 6.5×10^{-5} at room temperature (approx. 22°) whether or not small amounts of bicarbonate were present.

MAGNESIUM AMMONIUM PHOSPHATE $MgNH_4PO_4 \cdot 6H_2O$

SOLUBILITY IN AQUEOUS SALT SOLUTIONS AT 25°

(Uncles and Smith, 1946)

All data are reported as mg. of magnesium per liter of solution. In pure water 13.6 mg. of magnesium were found dissolved in a liter of saturated solution at 25°

Salt Solution	Normality of Salt Solution						
	0.001	0.005	0.010	0.025	0.050	0.075	0.100
NH_4OH	9.60	3.42	1.39	-	0.70	-	0.53
$(NH_4)_2HPO_4$	12.7	8.10	4.68	2.29	1.26	1.12	1.00
Na_2HPO_4	13.1	9.93	8.95	-	8.14	-	7.66

	Normality of Salt Solution						
	0.05	0.10	0.20	0.30	0.40	0.50	1.00
$(NH_4)_2C_2O_4$	38.8	57.0	89.5	121.0	152.0	180.0	
$(NH_4)_2C_2O_4$ in 0.01N NH_4OH	22.5	-	64.5	-	112.0	-	
$(NH_4)_2C_2O_4$ in 0.10N NH_4OH	8.76	-	27.1	-	47.7	-	
$(NH_4)_2C_2O_4$ in 1.00N NH_4OH	2.63	-	8.32	-	14.4	-	
$Na_2C_2O_4$	43.5	68.5	106.0	138.0	166.0	191.0	
$Na_2C_2O_4$ in 0.01N NH_4OH	22.1	-	60.5		109.0		
$Na_2C_2O_4$ in 0.10N NH_4OH	6.57	-	21.3		39.4		
$Na_2C_2O_4$ in 1.00N NH_4OH	2.40	-	7.00		11.9		
$(NH_4)_2MoO_4$	340.0	493.0	730.0				
$(NH_4)_2MoO_4$ in 0.05N NH_4OH	-	-	404.0				
$(NH_4)_2MoO_4$ in 0.20N NH_4OH	-	-	2.5				
KCl	-	18.8	-	-	-	26.4	29.8
KNO_3	-	17.9	-	-	-	24.6	26.0
K_2SO_4	-	21.9	-	-	-	34.2	39.2
$CaCl_2$	-	296				499	622
$CaCl_2$ in 0.1N NH_4OH	-	131				311	416
$CaCl_2$ in 1.0N NH_4OH	-	18.3				26.9	27.9
$CaCl_2$ in 2.0N NH_4OH	-	6.6				12.1	12.9
$BaCl_2$	-	125				184	199
$BaCl_2$ in 0.1N NH_4OH	-	70				140	155
$BaCl_2$ in 1.0N NH_4OH	-	15.3				26.0	27.6

	Normality of Salt Solution								
	0.10	0.25	0.50	0.75	1.00	1.50	2.00	3.00	5.00
NH_4OH	0.53		0.44		0.55			0.70	0.80
$(NH_4)_2HPO_4$	1.00		0.76		0.50				
NH_4Cl	19.1	25.9	38.0	46.0	53.0	61.5	67.0	79.0	86.0
NH_4Cl in 0.01N NH_4OH	7.24		16.5		22.0		30.0		
NH_4Cl in 0.10N NH_4OH	2.11		5.53		7.46		9.30		
NH_4Cl in 1.00N NH_4OH	1.20		2.96		4.20		5.60		
NH_4NO_3	19.3	24.6	35.0	42.0	46.5	52.0	54.0	56.5	59.0
NH_4NO_3 in 0.01N NH_4OH	6.80		14.4		19.1		26.0		
NH_4NO_3 in 0.10N NH_4OH	1.71		4.50		5.90		7.65		
NH_4NO_3 in 1.00N NH_4OH	1.22		2.80		4.00		5.30		

PO

	Normality of Salt Solution (Con.)								
	0.10	0.25	0.50	0.75	1.00	1.50	2.00	3.00	5.00
$(NH_3)_2SO_4$	24.1	35.8	52.2	64.0	73.0	87.0	97.5	119.0	148.0
$(NH_4)_2SO_4$ in 0.01N NH_4OH	9.24		22.7		35.0		56.0		
$(NH_4)_2SO_4$ in 0.10N NH_4OH	3.07		8.85		13.8		21.0		
$(NH_4)_2SO_4$ in 1.00N NH_4OH	1.25		3.70		5.90		10.0		
NaCl	22.3	27.2	32.0	35.0	37.0	39.4	40.2	39.6	36.2
NaCl in 0.01N NH_4OH	6.30		11.7		15.1		16.6		
NaCl in 0.10N NH_4OH	1.75		3.78		4.76		5.66		
$NaNO_3$	20.0	25.4	30.5	33.4	35.0	37.4	38.2	37.0	29.0
$NaNO_3$ in 0.01N NH_4OH	6.00		11.4		13.8		14.7		
$NaNO_3$ in 0.10N NH_4OH	2.70		6.35		8.86		12.7		
Na_2SO_4	25.0	32.0	38.6	42.8	46.0	51.0	54.0		
Na_2SO_4 in 0.01N NH_4OH	8.53		19.6		27.4		34.5		
Na_2SO_4 in 0.10N NH_4OH	2.70		6.35		8.86		12.7		
Na_2SO_4 in 1.00N NH_4OH	0.80		2.40		3.64		4.80		

SO MAGNESIUM SULFATE $MgSO_4$ See also p. 344

SOLUBILITY OF MAGNESIUM SULFATE IN WATER ABOVE 100°

(Benrath, 1941)

t°	Gms. $MgSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $MgSO_4$ per 100 Gms. Sat. Sol.	t°	Gms. $MgSO_4$ per 100 Gms. Sat. Sol.
125	45	210	30	210	15
165	40	212	25	210	5
182	35	210	20		

The metastable extensions of the saturation curves for $MgSO_4 \cdot 7H_2O$, $Na_2SO_4 \cdot 10H_2O$ and astrakanite ($MgSO_4 \cdot Na_2SO_4 \cdot 4H_2O$) in the system $MgSO_4$ + Na_2SO_4 + H_2O at 25° have been followed by Levina, 1938a. See also p. 325.

Batuner, 1938 found that 100 gms. of a saturated solution, containing 50 gms. of H_2SO_4, contained 4.25 gms. $MgSO_4$ at 35°, 45°, 55°, and 65°. The solid phase was $MgSO_4 \cdot H_2O$.

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SULFATE - NICKEL SULFATE - WATER

(Benrath and Neumann, 1939)

The salts form solid solutions at all temperatures from 0° to 100°.

The solid phases have the following composition:

t°	
Below 29.1	Continuous Solid Solution $(Mg,Ni)SO_4 \cdot 7H_2O$
29.1 to 44	Solid Solutions $(Mg,Ni)SO_4 \cdot 7H_2O$ and $(Mg,Ni \cdot \alpha)SO_4 \cdot 6H_2O$
44 to 48	Solid Solutions $(Mg,Ni)SO_4 \cdot 7H_2O$, $(Mg,Ni \cdot \beta)SO_4 \cdot 6H_2O$, and $(Mg,Ni \cdot \alpha)SO_4 \cdot 6H_2O$
48 to 60.3	Solid Solutions $(Mg,Ni \cdot \beta)SO_4 \cdot 6H_2O$ and $(Mg,Ni \cdot \alpha)SO_4 \cdot 6H_2O$
60.3 to 68	Continuous Solid Solution $(Mg,Ni \cdot \beta)SO_4 \cdot 6H_2O$
68 to 84.8	Solid Solutions $(Mg,Ni)SO_4 \cdot H_2O$ and $(Mg,Ni \cdot \beta)SO_4 \cdot 6H_2O$
84.8 to 100	Continuous Solid Solution $(Mg,Ni)SO_4 \cdot H_2O$

Melting points in the system $MgSO_4$ + Na_2SO_4 are given by Speranskaya, 1938

MAGNESIUM AMMONIUM SULFATE $Mg(NH_4)_2(SO_4)_2$ SO

At 25°, 16.61g. $Mg(NH_4)_2(SO_4)_2$ are contained in 100 gms. of a saturated solution in water. density = 1.090 (0.7176 moles/liter sat. sol.). The solid phase is $Mg(NH_4)_2(SO_4)_2 \cdot 6H_2O$. The result agrees fairly well with that of Porlezza (Vol. I, p. 988). (Hill, Durham, and Ricci, 1940)

MAGNESIUM THIOSULFATE MgS_2O_3 SO

SOLUBILITY OF MAGNESIUM THIOSULFATE IN WATER
(Silberman and Ivanov, 1946)

The salt begins to decompose $MgS_2O_3 \rightleftharpoons S + MgSO_3$ at about 70°.

t°	Gms. MgS_2O_3 per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. MgS_2O_3 per 100 gms. Sat. Sol.	Solid Phase
0	30.69	$MgS_2O_3 \cdot 6H_2O$	61.25	38.91	$MgS_2O_3 \cdot 6H_2O$
10.5	31.97	"	73.25	41.18	"
28	34.51	"	75.75	41.45 (+0.25 gms. MgS_2O_3)	"
36.5	35.48	"	80.75	42.80 (+0.18 gms ")	"
43.5	36.10	"	85.25	44.81 (+0.35 gms. ")	"
46.5	36.64	"	86.75	45.0 (+0.30 gms. ")	"
54	37.62	"			

Data are also given for the system $MgS_2O_3 + 2NaCl \rightleftharpoons Na_2S_2O_3 + MgCl_2$ in water at 25°.

MAGNESIUM SULFAMATE $Mg(H_2NSO_3)_2$ SON

SOLUBILITY OF MAGNESIUM SULFAMATE IN WATER
(King and Hooper, 1941)

Equilibrium was attained from both under saturation and super saturation.

t°	Gms. $Mg(H_2NSO_3)_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $Mg(H_2NSO_3)_2$ per 100 Gms. H_2O	Solid Phase
0	100.3	$Mg(H_2NSO_3)_2 \cdot 4H_2O$	50	135.3	$Mg(H_2NSO_3)_2 \cdot 4H_2O$
10	103.2	"	60	148.6	"
20	107.7	"	70	164.7	"
*25	110	"	75	177.8	"
30	114.2	"	80	197.8	"
40	122.8	"			

* Interpolated

Cupery, 1938 found the solubility of magnesium sulfamate in water to be 119 gms. per 100 gms. H_2O at 25°.

SeO MAGNESIUM SELENATE $MgSeO_4$

THE SOLUBILITY OF MAGNESIUM SELENATE IN WATER

(Klein, 1940)

The results are in serious disagreement with those of Meyer and Aulich (Vol. I, p. 995), but agree with the solubility at 30° determined by Lawrence and King, (Vol. I, p. 995), and that at 25° of Hill, Soth, and Ricci, below.

t°	Density	Gms. $MgSeO_4$ per 100 gms. Sat. Sol.	Gms. $MgSeO_4$ per 100 gms. H_2O	Solid Phase
-3.5	1.2057	18.89	23.28	Ice
-7.1	-	26.55	36.14	Ice + $MgSeO_4 \cdot 7H_2O$
0.0	1.3860	31.41	45.79	$MgSeO_4 \cdot 7H_2O$
3.6	-	-	-	$MgSeO_4 \cdot 7H_2O$ + $MgSeO_4 \cdot 6H_2O$
12.8	1.4333	34.78	53.30	$MgSeO_4 \cdot 6H_2O$
20	1.4400	35.32	54.61	"
30.4	1.4488	36.20	56.54	"
40	1.4640	37.14	59.08	"
46.2	1.4732	37.81	60.79	"
60	1.5003	39.84	63.30	"
75	1.5361	42.21	73.04	"
89.5	-	-	-	$MgSeO_4 \cdot 6H_2O$ + $MgSeO_4 \cdot 4.5H_2O$
*91.2	1.5940	45.50	83.48	$MgSeO_4 \cdot 6H_2O$
95	1.5986	45.71	84.19	$MgSeO_4 \cdot 4.5H_2O$
99.5	1.6065	46.50	86.91	"

* = Metastable

At 25° 35.70 gms. of Magnesium Selenate are dissolved in 100 gms. of a saturated solution in water. The solid phase is $MgSeO_4 \cdot 6H_2O$. (Hill, Soth, and Ricci, 1940).

EQUILIBRIUM IN THE SYSTEM MAGNESIUM SELENATE - SELENIC ACID - WATER AT 30°

(Furukawa and King, 1944)

Gms. $MgSeO_4$ per 100 gms. Sat. Sol.	Gms. H_2SeO_4 per 100 gms. Sat. Sol.	Solid Phase
34.02	4.61	$MgSeO_4 \cdot 6H_2O$
28.33	14.65	"
23.78	24.85	"
22.94	29.20	"
22.57	34.55	"
22.98	35.50	$MgSeO_4 \cdot 6H_2O$ + $MgSeO_4 \cdot 4H_2O$
23.01	37.77	$MgSeO_4 \cdot 4H_2O$
22.93	39.22	"
22.60	41.30	"
22.63	41.87	"
22.22	43.08	$MgSeO_4 \cdot 4H_2O$ + $MgSeO_4 \cdot H_2SeO_4 \cdot 6H_2O$
21.09	44.32	$MgSeO_4 \cdot H_2SeO_4 \cdot 6H_2O$
17.50	48.99	"
16.06	50.90	"
15.13	52.63	"
12.66	56.79	$MgSeO_4 \cdot H_2SeO_4 \cdot 6H_2O$ + $MgSeO_4$
10.10	59.60	$MgSeO_4$
7.28	63.47	"
3.24	70.29	"
1.98	74.09	"
1.68	76.11	"
1.28	77.69	"

THE SYSTEMS MAGNESIUM AMMONIUM SELENATE - MAGNESIUM AMMONIUM SULFATE - WATER AND MAGNESIUM AMMONIUM SELENATE - MAGNESIUM POTASSIUM SELENATE - WATER AT 25° SeO

(Hill, Soth, and Ricci, 1940)

The salts form continuous, hexahydrated solid solutions. Each determination was made in duplicate, and equilibrium was approached from two directions.

$Mg(NH_4)_2(SeO_4)_2 - Mg(NH_4)_2(SO_4)_2 - H_2O$

Sat. Sol. Wt. %		Solid Wt. %	
A	B	A	B
0.0	16.58	0.0	70.02
5.68	13.32	11.45	59.71
10.39	10.39	24.91	47.20
15.32	6.93	43.9	29.7
18.28	4.57	57.92	16.87
20.12	2.68	67.53	8.30
23.31	0.0	76.21	0.0

$Mg(NH_4)_2SeO_4 - MgK_2(SeO_4)_2 - H_2O$

Sat. Sol. Wt. %		Solid Wt. %	
A	C	A	C
23.31	0.0	76.21	0.0
19.01	5.96	67.98	8.18
15.07	11.91	58.22	18.15
11.42	17.16	47.23	29.61
9.07	20.50	38.81	38.26
7.29	22.97	30.59	46.61
0.0	32.15	0.0	78.23

A = $Mg(NH_4)_2(SeO_4)_2$ B = $Mg(NH_4)_2(SO_4)_2$ C = $MgK_2(SeO_4)_2$

MANGANESE BORATE $MnBO_3$ BO

100 gms. of a saturated solution in furfural contain 0.02 gms. of $MnBO_3$ at 25°. (Trimble, 1941)

MANGANESE ACETATE $Mn(C_2H_3O_2)_2 \cdot 4H_2O$ CH

100 gms. of a saturated solution in furfural contain 0.02 gms. $Mn(C_2H_3O_2)_2 \cdot 4H_2O$ at 25°. (Trimble, 1941)

MANGANESE CARBONATE $MnCO_3$ CO

SOLUBILITY OF MANGANESE CARBONATE IN WATER

(Smurov, 1938)

(The total pressure of $CO_2 + H_2O$ was one atmosphere)

Partial Pressure CO_2 in atm.	Gms. Mn per 100 gms. Sat. Sol.				
	5°	15°	40°	50°	80°
0.0005	0.0011	0.0009	0.0003	0.0002	0.0001
.005	.0026	.0022	.0008	.0006	.0002
.05	.0061	.0052	.0019	.0014	.0005
.10	.0078	.0068	.0025	.0018	.0007

Cl MANGANESE CHLORIDE $MnCl_2$

SOLUBILITY OF MANGANESE CHLORIDE IN WATER
(Benrath, 1941)

t°	Gms. $MnCl_2$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $MnCl_2$ per 100 gms. Sat. Sol.	Solid Phase
-25.6	30.5	Ice + $MnCl_2 \cdot 6H_2O$	272	69.6	$MnCl_2 \cdot H_2O$
-2	38.5	$MnCl_2 \cdot 6H_2O + MnCl_2 \cdot 4H_2O$	286	71.3	"
58.1	51.4	$MnCl_2 \cdot 4H_2O + MnCl_2 \cdot 2H_2O$	313	75.1	"
113	54.5	$MnCl_2 \cdot 2H_2O$	321	76.5	"
121	55.0	"	328	78.5	"
146	56.7	"	333	79.5	"
155	57.9	"	345	81.5	"
176	58.6	"	350	82.5	"
189	61.3	"	353	83.5	"
198	63.7	$MnCl_2 \cdot 2H_2O + MnCl_2 \cdot H_2O$	362	85.0	$MnCl_2 \cdot H_2O + MnCl_2$
217	64.5	$MnCl_2 \cdot H_2O$	392	85.5	$MnCl_2$
249	66.9	"	430	86.5	"

Additional data in the system $MnCl_2 + NH_4Cl + H_2O$ at 25° is given by Kurnakow and Woskressenskaya, 1937. The results confirm the findings of previous workers (Vol. I, p. 1001) in that the "compound" $2NH_4Cl \cdot MnCl_2 \cdot 2H_2O$ is merely one salt ratio in a solid solution which varies widely in composition.

Additional data is also given by Greenberg and Walden (1940) who allowed the salt mixtures to come to equilibrium over varying periods of time and studied the solid phases with X-rays. Their work does not agree with the conclusion of Benrath and Schackman, but confirms the work of the other previous workers (Vol. I, p. 1001)

100 cc of a saturated solution of $MnCl_2$ in a mixture of equal volumes of ethyl ether and water, saturated with HCl at 0°, contain 0.86 gms. $MnCl_2$. (Fischer and Seidel, 1941).

NO MANGANESE NITRATE $Mn(NO_3)_2$

SOLUBILITY OF MANGANESE NITRATE IN WATER
(Ewing and Rasmussen, 1942)

The results differ from those of Funk (Vol. I, p. 1004) who found only a hexa- and a trihydrate up to 35°. The present work indicates the presence of a hexa-, tetra-, di-, and monohydrates, but no trihydrate. $Mn(NO_3)_2 \cdot 6H_2O$ and $Mn(NO_3)_2 \cdot 4H_2O$ are stable at their melting points. The data were obtained by the freezing point method.

t°	Gms. $Mn(NO_3)_2$ per 100 gms. Sat. Sol.	Solid	t°	Gms. $Mn(NO_3)_2$ per 100 gms. Sat. Sol.	Solid
10.3	52.9	6	34.2	73.9	4
15.5	54.8	6	31.3	75.4	4
18.1	56.0	6	31.0	75.3	4
21.7	57.8	6	29.7	76.1	4
24.0	59.8	6	28.4	76.9	4
25.0	61.1	6	26.5	77.2	4
25.2	62.1	6	28.0	77.9	2
25.3	62.4	6 (M.P)	30.0	78.5	2
25.3	62.5	6	32.2	79.2	2
25.3	62.7	6	34.3	79.8	2
24.9	63.8	6	35.2	80.3	2
24.7	64.0	6 + 4	m 29.0	80.6	1
27.3	64.9	4	30.0	-	2 + 1
32.3	67.2	4	37.0	80.9	1
34.5	68.4	4	40.1	81.0	1
36.2	69.7	4	45.0	81.2	1
37.1	71.3	4 (M.P.)	50.0	81.6	1
37.0	71.5	4	59.9	82.1	1
36.8	71.7	4	68.1	82.8	1
36.6	72.2	4	75.0	83.3	1

NO

m = Metastable 6 = $Mn(NO_3)_2 \cdot 6H_2O$ 4 = $Mn(NO_3)_2 \cdot 4H_2O$

2 = $Mn(NO_3)_2 \cdot 2H_2O$ 1 = $Mn(NO_3)_2 \cdot H_2O$

EQUILIBRIUM IN THE SYSTEM MANGANOUS NITRATE - NITRIC ACID - WATER AT 20°

(Ewing and Glick, 1940)

In addition to the hydrates found in the system Manganous Nitrate - Water (6, 4, 2, and 1), the compounds $Mn(NO_3)_2 \cdot 1.5H_2O$ and $Mn(NO_3)_2 \cdot 0.5H_2O$ were found to be in equilibrium with solutions containing large amounts of HNO_3.

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
HNO_3	$Mn(NO_3)_2$		HNO_3	$Mn(NO_3)_2$	
0.0	56.9	$Mn(NO_3)_2 \cdot 6H_2O$	10.5	69.0	$Mn(NO_3)_2 \cdot 2H_2O$
2.5	55.5	"	16.2	65.2	"
5.9	54.6	"	18.6	63.7	"
6.5	56.6	"	19.9	62.7	$Mn(NO_3)_2 \cdot 2H_2O$ + $Mn(NO_3)_2 \cdot 1.5H_2O$
7.7	55.7	$Mn(NO_3)_2 \cdot 4H_2O$	24.4	58.3	$Mn(NO_3)_2 \cdot 1.5H_2O$
10.2	53.7	"	47.0	37.8	$Mn(NO_3)_2 \cdot 1.5H_2O$
11.4	52.8	"	46.9	37.8	+ $Mn(NO_3)_2 \cdot H_2O$
16.7	48.8	"	61.5	24.8	$Mn(NO_3)_2 \cdot H_2O$
26.9	41.8	"	68.1	19.1	"
31.9	40.8	"	69.0	18.5	"
28.4	45.7	"	78.0	11.7	"
19.4	57.0	"	84.1	7.4	$Mn(NO_3)_2 \cdot H_2O$ + $Mn(NO_3)_2 \cdot \frac{1}{2}H_2O$
13.3	63.6	"	88.6	4.7	$Mn(NO_3)_2 \cdot \frac{1}{2}H_2O$
9.5	68.0	"	91.5	3.5	"
5.9	72.4	$Mn(NO_3)_2 \cdot 2H_2O$	96.3	1.1	"
8.3	71.0	"	99.3	0.5	"

O MANGANESE OXIDE MnO

The following systems were investigated:

MnO + FeO	by X-rays	(Pettersson, 1946)
MnO + ZnO	at 900°	(Jay and Andrews, 1944) (Rigamonti, 1946)
$Si + 2MnO \rightleftharpoons SiO_2 + 2Mn$	at 1640°	(Herasymenko, 1938)

OH MANGANESE HYDROXIDE $Mn(OH)_2$

Oka, 1940 found the solubility of manganese hydroxide in water to be 3.1×10^{-5} moles per liter by potentiometric titration.

The solubility product of manganese hydroxide in KCl and NaCl solutions was determined by Näsänen, 1942, who found the thermodynamic product to be 1.89×10^{-13} at 25°.

SOLUBILITY OF MANGANESE HYDROXIDE IN ACIDIC AND BASIC SOLUTIONS AT 25°
(Fox, Swinehart, and Garrett, 1941)

The determinations were made in an atmosphere of nitrogen. Each value is the average of a determination in which equilibrium was approached from undersaturation and one form approached from supersaturation.

In NaOH Solutions		In HCl Solutions			
Moles NaOH per 1000 gms. H_2O	Moles $Mn(OH)_2$ per 1000 gms. $H_2O \times 10^5$	Mole HCl per 1000 gms. H_2O	Moles $Mn(OH)_2$ per 1000 gms. $H_2O \times 10^5$	Moles HCl per 1000 gms. H_2O	Moles $Mn(OH)_2$ per 1000 gms. $H_2O \times 10^5$
0.0	4.1*	0.00150	74.5	0.00850	430
1.924	7.5	.00200	102	.0120	605
2.880	14.7	.00300	141	.0160	805
3.72	24.2	.00500	249	.0200	985
4.14	29.2	.00600	298		

* Average of 6 determinations ($K_{sp} = 1.6 \times 10^{-13}$)

PO MANGANESE Hydrogen PHOSPHATE $MnHPO_4$

SOLUBILITY OF MANGANESE HYDROGEN PHOSPHATE IN PHOSPHORIC ACID SOLUTIONS AT 100°
(Taperova and Isaeva, 1949)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
P_2O_5	MnO		
0.08	Trace	1.1190	$MnHPO_4$
2.38	0.24	1.1290	"
18.52	2.73	1.1631	"
19.82	3.13	-	"
22.43	4.85	1.1880	"
28.37	4.04	1.3987	"
32.95	6.19	-	"
36.90	6.25	1.5304	"
39.50	7.11	-	"
48.50	12.00	-	$MnHPO_4 + MnH_4(PO_4)_2 \cdot H_2O$

Data of Taperova and Isaeva, 1949 (Con.)

Metastable Equilibrium Data FC

Gms. per 100 gms. Sat. Sol. P_2O_5	Gms. per 100 gms. Sat. Sol. MnO	Density	Solid Phase
4.20	0.87	1.2799	$MnHPO_4 \cdot 3H_2O$
4.27	1.26	1.3251	"
11.04	5.20	1.4280	"
15.00	5.40	1.5227	"
23.81	7.15	-	$MnHPO_4 \cdot 3H_2O + MnHPO_4$
26.20	6.33	1.5462	"
34.70	10.70	1.6157	"
43.50	13.85	1.7877	"
46.22	13.31	1.9725	"
50.26	9.63	1.7575	$MnH_4(PO_4)_2 \cdot 2H_2O$
54.80	8.17	1.7021	"
56.00	6.90	1.6410	"

The solubilities of various soil phosphates (including manganese) under varying conditions were determined by Fraps, 1911.

Data for the system $MnO - P_2O_5 - H_2O$ at 25° are given by Amadori (1922).

MANGANESE SULFIDE MnS S

Kapustinsky (1940) calculated the solubility product of manganese sulfide to be 1.1×10^{-15}

MANGANOUS SULFATE $MnSO_4$ SO

SOLUBILITY OF MANGANOUS SULFATE IN WATER
(Rohmer, 1988)

The results extend those of previous authors (Vol. I, p. 1006). An entirely metastable dihydrate was found in addition to the tetrahydrate already reported.

t°	Gms. $MnSO_4$ per 100 gms. Sat. Sol.	Density	Solid phase
23.9	39.0	1.494	$MnSO_4 \cdot 5H_2O + MnSO_4 \cdot H_2O$
^{m}26.1	39.4	1.500	$MnSO_4 \cdot 5H_2O + MnSO_4 \cdot 2H_2O$
^{m}27.5	39.7	1.503	$MnSO_4 \cdot 5H_2O + MnSO_4 \cdot 4H_2O$
^{m}31	40.4	1.513	$MnSO_4 \cdot 5H_2O$
^{m}34	41.0	1.521	"
^{m}38	41.7	1.532	"
^{m}42	42.2	1.542	"
^{m}31	40.0	1.505	$MnSO_4 \cdot 4H_2O$
^{m}34	40.2	1.507	"
^{m}38	40.6	1.510	"
^{m}42	41.0	1.513	"
^{m}31	39.3	1.499	$MnSO_4 \cdot 2H_2O$
^{m}34	39.3	1.499	"
^{m}38	39.2	1.498	"
^{m}42	39.2	1.497	"
31	38.4	1.480	$MnSO_4 \cdot H_2O$
34	38.2	1.475	"
38	37.7	1.467	"
42	37.3	1.460	"

m = metastable

SO

SOLUBILITY IN WATER AND IN DEUTERIUM OXIDE ABOVE 100°

(Eddy, Machemer, and Menzies, 1941)

The estimated accuracy of the results is 2 - 3%.

t°	Gms. $MnSO_4$ per 100 gms. H_2O	Solid Phase	t°	Gms. $MnSO_4$ per 100 gms. H_2O	Solid Phase
90	36.4	$MnSO_4 \cdot H_2O$	140	7.2	$MnSO_4 \cdot H_2O$
100	28.8	"	150	4.15	"
110	22.2	"	160	1.96	"
120	16.2	"	170	0.76	"
130	11.3	"			

t°	Gms. $MnSO_4$ per 100 gms. D_2O
99.0	24.8
116.1	12.9
138.1	4.48

SOLUBILITY OF MANGANESE SULFATE IN WATER ABOVE 100°

(Benrath, 1941)

[Solid Phase $MnSO_4 \cdot H_2O$]

t°	Gms. $MnSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $MnSO_4$ per 100 gms. Sat. Sol.	t8	Gms. $MnSO_4$ per 100 gms. Sat. Sol.
107	40	155	25	180	10
132	35	160	20	188	5
141	30	170	15		

SeO

MANGANESE SELENATE $MnSeO_4$

SOLUBILITY IN WATER

(Klein, 1940)

t°	Gms. $MnSeO_4$ per 100 gms. Sat. Sol.	
30	36.8	$MnSO_4 \cdot 5H_2O$ (?)
60	35.4	$MnSO_4 \cdot 2H_2O$ (?)

Mo

MOLYBDENUM Mo

The distribution of molybdenum between Fe and FeS at the eutectic temperature of the system was studied by Noddack, Noddack and Bohnstedt, 1940. The molybdenum was concentrated in the Fe layer.

O

MOLYDIC OXIDE MoO_3

Melting points in the system $MoO_3 - WO_3$ are given by Rieck, 1943.

NITROGEN N_2 See also p. 91 N

SOLUBILITY OF NITROGEN IN WATER

(Cassato, 1904)

Note:

Values for k in the equation $l = kP$ where l is the Ostwald solubility coefficient and P is the total pressure. Interpolated from the author's data.

Total pressure Meters	k		Total Pressure Meters	k	
	19.4	24.9		19.4	24.9
0.900	0.01617	0.01498	5.000	0.01548	0.01427
1.000	.01616	.01493	6.000	.01521	.01410
2.000	.01600	.01482	7.000	.01501	.01383
3.000	.01584	.01460	8.000	.01476	.01371
4.000	.01564	.01444			

Orcutt and Seevers' (1937) value for the solubility of nitrogen in water at 25° is $\alpha = 0.0149$, while that of VanSlyke (1939) at 23° is 0.0153.

SOLUBILITY OF NITROGEN IN LIQUID SULFUR DIOXIDE

(Dean and Walls, 1947)

The results disagree with those of Donte and Ferguson (Vol. I, p. 1027) which showed a considerably greater solubility. The authors point out that the relatively large vapor-volume corrections made by the previous workers may have introduced large errors.

t °F	Pressure Lbs. per sq. In. Absolute	cc. N_2 (32°F, 1 Atm.) per gm. SO_2	t °F	Pressure Lbs. per Sq. In. Absolute	cc. N_2 (32°F, 1 Atm.) per gm. SO_2
83.0	515	5.0	-25.7	515	2.8
83.0	225	1.8	-25.7	262	1.2
-4.0	253	1.9	-25.7	*	0.06

* 1 Atm. Partial Pressure of Nitrogen.

Data for the system $N_2 - SO_2$ from 25° to 40° at pressures up to 9000 Kg/cm^2 are given by Tsiklis, 1947.

A nomograph for the solubility of nitrogen in liquid ammonia is given by Davis, 1941.

The solubility of nitrogen-methane mixtures in liquid ammonia from -20° to 50° up to 560 atm. has been determined by Bolshakov and Lebedeva, 1940.

SOLUBILITY OF NITROGEN IN METHANOL

(Krichevskii and Lebedeva, 1947)

cm^3 of nitrogen measured at 0°, 760 mm. dissolved in 1 gm. of methanol.

Pressure Atm.	0°	25°	50°	75°
48.4	7.7	8.2	8.7	9.3
97.8	15.1	16.4	17.4	18.7
145	21.9	23.2	25.1	27.1
194	28.5	30.5	33.1	36.0
242		37.2	40.1	44.5
280			-	51.6
291			47.4	-

SOLUBILITY OF NITROGEN IN ABSOLUTE ETHYL ALCOHOL

(Carius, 1855)

The density of the alcohol at 20° was 0.792.

t°		t°	
0	0.1263	15	0.1214
5	.1244	20	.1204
10	.1228	25	.1196

SOLUBILITY OF NITROGEN IN ORGANIC SOLVENTS

(Gjaldbaek and Hildebrand, 1949)

$$\alpha = \frac{\text{Volume of } N_2 \text{ at Temp. of Expt.}}{\text{Volume of Solvent}} \times \frac{760}{P}$$

Solvent		t°	α
n - Perfluoroheptane	C_7H_{16}	0	0.411
		25	.385
		50	.360
Perfluoromethyl Cyclohexane	C_7F_{14}	25	.375
Perfluorodimethyl Cyclohexane	C_8F_{16}	25	.328
		50	.317
Cyclohexane	C_6H_{12}	25	.156
Benzene	C_6H_6	25	.124
Carbon Disulfide	CS_2	25	.0823
n - Hexane	C_6H_{14}	25	.239

SOLUBILITY OF NITROGEN AND AIR IN ORGANIC SOLVENTS

(Kretschmer, Nowakowska, and Wiebe, 1946)

The authors used a method similar to that of Horiuti (Vol. I, p. 1025), and the results are in excellent agreement with those of Horiuti but disagree with those of Just (also p. 1025). Considerable care was taken to obtain solvents of high purity. The results are in terms of the Ostwald Solubility Coefficient. (ml. gas dissolved in 1 ml. of solvent at 1 atm. pressure and the temperature of the experiment.) Data for oxygen are found on p. 496.

t°	Ostwald Coefficient		t°	Ostwald Coefficient	
	N_2	Air (calc'd)		N_2	Air (calc'd)
	Absolute Ethanol			n - Butanol	
-25	0.1280	0.1523	0	0.1075	0.1296
0	.1391	.1615	25	.1225	.1417
25	.1489	.1692	50	.1358	.1536
50	.1606	.1798			
	95% Ethanol by Volume (+ H_2O)			Acetone	
			-25	0.1340	0.1570
-25	0.0944	0.1137	0	.1554	.1777
0	.1053	.1232	25	.1816	.2031
25	.1160	.1326			
50	.1290	.1450			

Data of Kretschmer, Nowakowska, and Wiebe, 1946 (Con.)

t	Ostwald Coefficient N_2	Ostwald Coefficient Air (calc'd)	t°	Ostwald Coefficient N_2	Ostwald Coefficient Air (calc'd)
	Methanol			Iso-Octane	
-25	0.1435	0.1652	-25	0.1943	0.2367
0	.1532	.1733	0	.2088	.2442
25	.1645	.1827	25	.2258	.2580
50	.1765	.1937	50	.2452	.2762
	Isopropanol			50% Acetone in Ethanol by Volume	
0	0.1353	0.1592	0	0.1427	0.1643
25	.1465	.1684	25	.1609	.1816
50	.1617	.1822	50	.1829	.2028
				50% Iso-Octane in Ethanol by Volume	
			0	0.1785	0.2077
			25	.1939	.2208
			50	.2100	.2347

For further data on the solubility of air in organic solvents, see p.

At 77°, 1 atm. partial pressure of nitrogen, 0.15 cc (32°F. 1 atm.) of nitrogen dissolve in 1 gm. of carbon tetrachloride. Dean and Walls, 1947

SOLUBILITY OF NITROGEN IN LIQUID METHANE AND PROPANE AT -183°

(Vellinger and Pons, 1945)

The apparatus was immersed in liquid oxygen. The data were read from curves given by the authors:

Total Pressure mm	cc N_2 Dissolved in 100 cc of Methane	cc N_2 Dissolved in 100 cc of Propane	Total Pressure mm	cc N_2 Dissolved in 100 cc of Methane	cc N_2 Dissolved in 100 cc of Propane
150	1.2	0.7	500	7.9	1.7
250	2.5	1.0	650	14.3	2.4
350	4.1	1.3	750	26	

The solid-liquid equilibria of the systems nitrogen-methane and nitrogen-argon were studied by Federova (1939) from heat capacity curves.

Liquid-Vapor equilibrium data for the system nitrogen-benzene at high pressures is given by Miller and Dodge, 1940.

The solubility of nitrogen in ethylene at 0° and pressures up to 7000 Kg./cm.^{2} has been determined by Tsiklis, 1947a.

SOLUBILITY OF NITROGEN IN OILS

	ml. N_2 (0°, 760 mm.) per 100 ml. of Oil					
	21.5°	22°	32°	37°	40°	60°
Olive Oil	6.44[5]	5.2[1]	-	6.7[2][3]	-	-
Corn Oil	-	6.3[2]	-	6.3[2]	-	-
Paraffin Oil	-	-	7[4]	-	-	-
Butter Oil	-	-	-	-	8.9[6]	7.9[6]
Cottonseed Oil	-	-	-	-	6.2[6]	-
Lard	-	-	-	-	6.6[6]	-

(1) Vernon, 1907
(2) Vibrans, 1935
(3) Behnke and Yarbrough, 1938
(4) Nasini and Coraldi, 1932
(5) Van Slyke, 1939
(6) Schaffer and Haller, 1943

SOLUBILITY OF NITROGEN IN POLY STYRENE AT 170°

(Newitt and Weale, 1948)

P (atm.) of H_2	287	282.5	232	187	182	118
cc of H_2 (at 0°, 1 atm.) per gm. of Poly Styrene	7.77	7.93	6.15	5.57	5.02	2.95

SOLUBILITY OF NITROGEN IN RUBBER

(Carpenter, 1947)

Composition of sample, parts by weight: Smoked Sheet Rubber 100, Sulfur 2.5, ZnO 3.0, Stearic Acid 1.0, Mercapto Benzthiazole 0.5, Agrite White 0.5. A vulcanized cylindrical piece was used and the adsorption was carried out in the dark. Diffusion rates were also measured. The results differed by as much as 10% depending on the method of calculation.

t°	Gms. N_2 per cc Rubber per Atm.	cc N_2 (0°, 760mm) per 100 cc Rubber per Atm.	t°	Gms. N_2 per cc Rubber per Atm.	cc N_2 (0°, 760mm) per 100 cc Rubber per Atm.
21	-	4.4 (3.5)[a]	35	6.1×10^{-5}	-
25	-	4.6 (3.5)[b]	40	6.4×10^{-5}	-
25.3	5.6×10^{-5}	-	45	6.2×10^{-5}	-
30	5.9×10^{-5}	-	50	6.4×10^{-5}	-

[a] Venable and Fuwa, 1922
[b] Barrer, 1941

The solubility of nitrogen in blood at 23° was determined by Conant and Scott, 1926.

Data for the absorption of nitrogen in solutions of organic dyes are given by Weigert, 1910.

Data for the solubility of nitrogen in iron are given by Eisenhutu and Kaupp (1930), Hayasi (1940), and Krichevskii and Khazanova (1947).

HYDRAZINE N_2H_4

FREEZING POINTS IN THE SYSTEM HYDRAZINE - WATER
(Mohr and Andrieth, 1949)

The solutions were handled in an atmosphere of nitrogen in order to prevent oxidation or adsorption of carbon dioxide from the air. The results are not in good agreement with those of Semishin, 1938 below 75% N_2H_2, although the general nature of the system is the same. Semishin's curves are displaced in the direction of higher N_2H_2 content. The data below were selected from the many determinations listed by the authors.

Gms. N_2H_4 per 100 gms. Sat. Sol.	Freezing Point	Solid	Gms. N_2H_4 per 100 gms. Sat. Sol.	Freezing Point	Solid
5.40	-3.80°	Ice	49.3	-61.7°	1:1
11.9	-9.80°	"	59.9	-52.6°	"
14.3	-12.7°	"	64.0	-51.7°	1:1*
19.0	-20.4°	"	66.5	-52.2°	1:1
24.1	-30.8°	"	69	-54°	1:1 + N_2H_4
27.5	-41.6°	"	72.6	-40.2°	N_2H_4
29.6	-46.3°	"	81.0	-20.4°	"
35.6	-65.9°	"	90.1	-8.70°	"
45.0	-75.8°	1:1	100.0	+2.0°	"

*Melting point of $N_2H_4 \cdot H_2O$. Semishin's melting point is -46.8°.

SOLUBILITY OF UREA IN HYDRAZINE AND VICE VERSA
(Semishin, 1939)

t°	Mole % $CO(NH_2)_2$ in Sat. Sol.	Solid Phase	t°	Mole % $CO(NH_2)_2$ in Sat. Sol.	Solid Phase
+ 1.7	0.0	N_2H_4	-24.0	34.29	$CO(NH_2)_2$
-1.0	3.5	"	+11.4	39.73	"
-3.4	7.11	"	32.0	44.39	"
-6.2	10.48	"	43.3	48.02	"
-8.9	13.55	"	55.7	51.19	"
-12.6	16.42	"	72.0	55.30	"
-16.2	19.14	"	80.4	58.76	"
-25.4	29.00	"	89.8	65.40	"
-29.4	31.45	"	94.0	69.15	"
-32.9	33.7	$N_2H_4 + CO(NH_2)_2$	100.0	73.66	"
			104.8	78.27	"
			126.1	94.92	"
			132.7	100.0	"

MELTING POINTS IN THE SYSTEM HYDRAZINE - PHENOL
(Semishin, 1939a)

t°	Sat. Sol. Mole % C_6H_5OH	Solid Phase	t°	Sat. Sol. Mole % C_6H_5OH	Solid Phase
+1.7	0.0	A	11.8	34.58	1:2
-8.8	11.02	A	22.0	39.73	"
-11.1	13.05	A	30.2	43.57	"
-14.3	16.12	A	40.0	48.14	"
-19.5	19.78	A	46.6	51.07	"
-24.8	22.0	A + 1:2	52.6	54.63	"
-19.3	22.86	1:2	57.6	57.58	"
-11.2	25.91	"	60.1	60.54	"
+0.4	30.00	"	62.8	64.89	"

Data of Semishin, 1939a (Con.)

t°	Sat. Sol. Mole % C_6H_5OH	Solid Phase	t°	Sat. Sol. Mole % C_6H_5OH	Solid Phase
63.5	66.67	1:2	45.6	82.98	1:2
63.2	68.22	"	37.0	85.74	"
62.4	71.83	"	30.0	87.48	"
60.8	74.53	"	24.4	89.3	1:2 + B
58.4	76.40	"	30.3	87.48	B
54.0	78.94	"	35.7	96.21	B
50.0	81.15	"	40.8	100.0	B

H

A = N_2H_2 B = C_6H_5OH 1:2 = $N_2H_2 \cdot 2C_6H_5OH$

Melting points have been determined for the following:

— N_2H_4 + Thymol, + Acetamide, + Diphenylamine, Acetic Acid, Butyric Acid, Valeric Acid, Benzoic Acid, Salicylic Acid, Lauric Acid (in part), Palmitic Acid (in part). Semishin, 1943

—The viscosities and specific gravities in the system N_2H_4 + Acetic Acid were determined at 0°, 25°, 50°, and 75°. - Semishin, 1944.

H NO HYDRAZINE NITRATE $N_2H_4 \cdot HNO_3$

Melting point diagrams for the systems of hydrazine nitrate with the following salts have been determined by Barlot and Marsaule, 1948:

KNO_3, $CsNO_3$, $RbNO_3$, $NaNO_3$, $LiNO_3$, NH_4NO_3.

H.SO HYDRAZINE SULFATE $N_2H_4 \cdot H_2SO_4$

Correction to Volume I: p. 1030 "Hydrazine Sulfates"

The reference is Z. anorg Chem. 94 51-91 (1916)

SOLUBILITY OF HYDRAZINE SULFATE IN WATER ABOVE 100°

(Benrath, 1942)

t°	Gms. $N_2H_4 \cdot H_2SO_4$ per 100 gms. Sat. Sol.	t°	Gms. $N_2H_4 \cdot H_2SO_4$ per 100 gms. Sat. Sol.	t°	Gms. $N_2H_4 \cdot H_2SO_4$ per 100 gms. Sat. Sol.
94	14	143	35	186	55
108	20	152	40	193	60
118	25	163	45	208	65
129	30	174	50	216	70

H

AMMONIA NH_3

Henry's law constants for the system $NH_3 - H_2O$ at 100° for solutions containing up to 1.5 gms. NH_3 per liter by Calingaert and Huggins, 1923.

A very careful determination of the conductivity and vapor pressure of solutions of ammonia in water at 0°, 10°, 18°, and 25° was made by Morgan and Maas, 1931.

SOLUBILITY OF AMMONIA IN ALCOHOLS

(Hatem, 1949)

The densities of unsaturated solutions were determined at each temperature.

t°	Methyl Alcohol	Ethyl Alcohol	n - Propyl Alcohol	Isopropyl Alcohol
	- Moles NH_3 per liter -			
0	13.65	8.65	7.07	6
10	10.85	6.62	5.3	4.55
15	9.66	5.69	4.65	4.05
20	8.42	5.02	4.15	3.48
25	7.30	4.32	3.62	2.98
30	6.19	3.79	3.25	2.52
35	5.34	3.30	2.39	2.25
40	4.60			

Melting points in the system ammonia - acetamide indicate the presence of a 1:1 compound. (Sisler, Davidson, Stoenner, and Lyon, 1944).

AMMONIUM BROMIDE NH_4Br

Br

Correction to Volume I, p. 1054 "Solubility of Ammonia Polyhalides in H_2O and CCl_4"

The authors state the units of the second column to be "Gram-Atoms of Halogen per liter" instead of "Gm. mols. of Cmpd." as written. The compounds as such were insoluble in CCl_4 and the units refer to the concentration of IBr in CCl_4 formed by their dissociation.

EQUILIBRIUM IN THE SYSTEM AMMONIUM BROMIDE - AMMONIUM CHLORIDE - WATER AT 25°

(Platt and Burkhardt, 1944)

Br

Moles per mole of Dissolved Salts		Mole % NH_4Br in Solid	Moles per mole of Dissolved Salts		Mole % NH_4Br in Solid
NH_4Br	H_2O		NH_4Br	H_2O	
0.0	7.47	0.0	54.3	5.91	52.7
16.2	6.92	3.8	59.8	5.95	72.0
24.9	6.64	6.2	63.0	5.94	75.6
34.5	6.38	11.0	78.2	6.30	90.7
42.3	6.12	17.2	100.0	6.92	100.0
48.3	5.89	33.2			

100 grams of a saturated solution of ammonium bromide in liquid SO_2 contain 0.052 gms. NH_4Br at 25°. (Shatenstein and Viktorov, 1937).

SOLUBILITY OF AMMONIUM BROMIDE IN ALCOHOLS

(Bedwell, 1948)

t°	Methyl Alcohol	Ethyl Alcohol	n - Propyl Alcohol
0	10.62	2.968	0.9082
10	11.53	3.154	1.033
20	12.33	3.356	1.158
30	13.09	3.583	1.269
40	14.07	4.260	1.357
50	14.88	4.412	1.397
60	15.63	4.552	1.476
70	-	4.709	1.501
80	-	-	1.576
90	-	-	1.613

The conductivities in the system Al_2Br_6 - NH_4Br - Nitrobenzene at various temperatures were determined by Bigich, 1949.

CH **AMMONIUM ACETATE** $NH_4C_2H_3O_2$

MELTING POINTS IN THE SYSTEM AMMONIA - ACETIC ACID

(Davidson, Sisler, and Stoenner, 1944)

t°	Mole % NH_3	Solid Phase	t°	Mole % NH_3	Solid Phase	t°	Mole % NH_3	Solid Phase
50.1	23.7	A	119.0	53.1	C	6.5	74.4	D
59.5	26.3	A	120.0	54.5	C	4.5	75.7	D
66.0	30.2	A	119.5	55.2	C	3.0	76.2	D
66.5	31.3	A	119.5	55.7	C	-1.0	78.0	D
67.0	32.6	A	119.5	56.0	C	-3.0	78.6	D
69.0	34.0	B	118.0	59.0	C	-7.0	80.2	D
73.5	34.9	B	116.4	61.4	C	-9.0	81.2	D
79.5	35.9	B	113.0	63.9	C	-20.5	84.6	D
96.5	39.6	B	109.5	66.0	C	-29.5	87.3	D
100.5	40.8	B	104.5	67.8	C	-35.5	88.8	E
106.5	43.3	B	100.0	69.2	C	-34.0	89.6	E
112.0	45.6	B	91.0	71.2	C	-34.5	90.9	E
114.0	46.7	B	87.0	71.9	C	-40.5	92.6	E
115.5	48.0	B	85.0	72.2	C	-61.5	97.6	E
117.0	50.0	B	81.0	72.7	C	-64.0	98.0	E
117.0	51.0	B	78.0	73.2	C	-77.5	98.9	F
117.0	51.6	B	68.5	73.7	C	-78.5	99.3	F
			40.0	74.2	C	-77.5	100.0	F

A = $NH_3 \cdot 2HC_2H_3O_2$ B = $NH_3 \cdot HC_2H_3O_2$ C = $5NH_3 \cdot 4HC_2H_3O_2$

D = $2NH_3 \cdot HC_2H_3O_2$ E = $9NH_3 \cdot HC_2H_3O_2$ F = NH_3

AMMONIUM LACTATE $NH_4[CH_3CHOHCOO]$

FREEZING POINTS OF AMMONIUM LACTATE SOLUTIONS
(Dietz, Degering, and Schopmeyer, 1941)

Gms. per 100 gms. Sat. Sol.	Density d_4^{25}	Freezing Point t°
5	1.0092	-1.9
10	1.0218	-3.30
20	1.0461	-7.6
30	1.0703	-14.8
40	1.0954	-21.1
60	1.1394	-51.8

Data are also given for the viscosities, densities, refractive indices, boiling points, and surface tensions of unsaturated solutions at 25°.

AMMONIUM HYDROGEN TARTARATE $NH_4HC_4H_4O_6$ CH

SOLUBILITY OF AMMONIUM ACID TARTRATE IN UREA AND DIOXANE SOLUTIONS
(Pedersen, 1941)

17.85°		18.00°	
Moles Urea per liter of Solvent	Moles $NH_4HC_4H_4O_6$ per liter Sat. Sol.	Moles Dioxane per liter of Solvent	Moles $NH_4HC_4H_4O_6$ per liter Sat. Sol.
0.0	0.1494	0.0	0.1499
0.250	.1527	0.250	.1403
.500	.1558	.500	.1310
.750	.1590	.750	.1223
1.000	.1621		

AMMONIUM 2,4 DINITRO PHENATE $[C_6H_3(OH)(NO_2)_2]NH_4$ CH
AMMONIUM 2,4 DINITRO CRESYLATE $[C_6H_2(OH)(CH_3)(NO_2)_2]NH_4$ See note p. 66

Between 0.25 and 0.5 gms. NH_4 D.N.P. dissolve in 100 gms. sat. sol at 4°
" 0.8 " 1.0 " " " " " " " " "15°
" 0.5 " 1.0 " NH_4 D.N.C. " " " " " " "15°

(Pastac and Lecrivain, 1948)

AMMONIUM FERRO CYANIDE $(NH_4)_4Fe(CN)_6$ CN

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE - AMMONIUM FERROCYANIDE - WATER
(Irving and Cherry, 1941)

t°	Gms. per 100 gms. Sat. Sol.		Solid Phase
	NH_4Cl	$(NH_4)_4Fe(CN)_6$	
0	13.6	9.7	$2NH_4Cl \cdot (NH_4)_4Fe(CN)_6$
	8.7	18.9	"
	7.0	21.9	"
25.1	28.3	0.0	NH_4Cl

Data of Irving and Cherry, 1941 (Con.)

	t°	Gms. per 100 gms. Sat. Sol. NH_4Cl	Gms. per 100 gms. Sat. Sol. $(NH_4)_4Fe(CN)_6$	Solid Phase
C'N	25.1	28.0	0.3	NH_4Cl
		27.8	0.4	"
		27.3	1.2	NH_4Cl + $2NH_4Cl\cdot(NH_4)_4Fe(CN)_6$
		27.3	1.0	"
		25.3	2.3	$2NH_4Cl\cdot(NH_4)_4Fe(CN)_6$
		17.1	10.3	"
		14.7	14.0	"
		8.5	24.7	"
		6.2	30.0	"
		3.7	36.7	"
		0.8	44.6	"
		0.6	53.8	$2NH_4Cl\cdot(NH_4)_4Fe(CN)_6$ + $(NH_4)_4Fe(CN)_6$
		1.0	53.6	"
		0.3	51.7	$(NH_4)_4Fe(CN)_6$
		0.0	51.3	"
	40.05	31.6	0.0	NH_4Cl
		29.9	0.8	"
		29.6	1.3	"
		28.4	1.8	NH_4Cl + $2NH_4Cl\cdot(NH_4)_4Fe(CN)_6$
		28.4	1.6	"
		24.3	4.5	$2NH_4Cl\cdot(NH_4)_4Fe(CN)_6$
		23.6	5.2	"
		15.9	13.9	"
		9.5	25.2	"
		3.7	41.2	"
		1.0	54.6	$2NH_4Cl\cdot(NH_4)_4Fe(CN)_6$ + $(NH_4)_4Fe(CN)_6$
		1.1	53.3	"
		1.0	64.6	$(NH_4)_4Fe(CN)_6$
		0.6	54.1	"
		0.9	54.9	"
		0.0	54.7	"

CNS AMMONIUM THIOCYANATE NH_4CNS

THE SYSTEM AMMONIUM THIOCYANATE - PHENOL - WATER

(Merclin, 1940)

The system was studied at 20°, 30°, 40°, and 50° and contains an immiscibility gap between the solutions of ammonium thiocyanate rich in water and those rich in phenol. The two liquids become more miscible as the temperature is increased, and at 50° there is only one liquid phase in the system. The separate smaller miscibility gaps remain, instead of the one large gap at lower temperatures. The author gives data for the composition of solutions which are in equilibrium with a second liquid layer, but does not indicate which phases are coexistent. The maximum solubility of NH_4CNS in each layer is given below. [These are the compositions of the liquid phases which are in equilibrium with each other, and with excess solid NH_4CNS].

t°	Water-Rich Layer Wt. %		Phenol-Rich Layer Wt. %	
	C_6H_5OH	NH_4CNS	C_6H_5OH	NH_4CNS
20	4.0	61.0	77.0	11.4
30	4.0	64.5	77.3	12.5
40	3.0	69.7	77.7	13.0
50	2.1	73.5	77.6	14.0

AMMONIUM CARBONATE $(NH_4)_2CO_3$ CO

SOLUBILITY OF AMMONIUM CARBONATE IN AMMONIA SOLUTIONS

(Guyer, Biller, and Orelli, 1940)

The results are reported in the form of diagrams only, and the following data were read from the curves:

% NH_3 in Solvent	Gms. $(NH_4)_2CO_3$ per 100 gms. Solvent			
	-30°	-10°	0°	20°
10	-	9	22	29.5
20	1	3	15	23
30	1	1.5	10	13.5
40	1	1.5	7.5	9
60	1	1.5	6.5	8
70	1	1.5	7.5	3.5
80	1	1.5	7	0.5
90	1	1.5	4	-

100 grams of a saturated solution of ammonium carbonate in furfural contain 1.7 gms. $(NH_4)_2CO_3 \cdot H_2O$ at 25°. (Trimble, 1941).

AMMONIUM BICARBONATE NH_4HCO_3 HCO

SOLUBILITY OF AMMONIUM BICARBONATE IN AMMONIA SOLUTIONS AT ONE ATMOSPHERE PRESSURE

(Guyer and Piechowicz, 1944)

t°	Gms. per 100 gms. Sat. Sol.		t°	Gms. per 100 gms. Sat. Sol.	
	NH_4HCO_3	NH_3		NH_4HCO_3	NH_3
20	17.4	0.26	40	28.0	2.27
25	19.2	.57	45	32.2	3.29
30	21.6	.96	50	36.8	4.48
35	24.4	1.55			

Further data in the system $NH_3 - CO_2 - H_2O$ are also given by the authors, including solubility data for $NH_4CO_2NH_2$, $(NH_4)_2CO_3$ and other salts. Data for the system $NH_4HCO_3 + (NH_4)_2SO_4 + NH_3 + H_2O$ is given by Guyer and Piechowicz, 1945.

Data for the solubility of NH_4HCO_3 in water saturated with CO_2 from 30° to 70° and from 10 to 70 atm. pressure is given by Utida, 1940.

EQUILIBRIUM IN THE SYSTEM $2NH_4HCO_3 + Na_2SO_4 \rightleftharpoons 2NaHCO_3 + (NH_4)_2SO_4$ AT 32.5°

(Belopolski and Urussov, 1935)

Gms. per 100 gms. Sat. Sol.			Solid Phase
Na_2SO_4	$(NH_4)_2CO_3$	$(NH_4)_2SO_4$	
33.62	0.0	0.0	Na_2SO_4
32.64	1.81	0.0	"
31.70	3.52	0.0	"
30.53	5.19	0.0	"
29.80	7.15	0.0	"
28.00	10.44	0.0	"
25.90	14.80	0.0	"
24.57	18.54	0.0	"
24.16	19.21	0.10	$Na_2SO_4 + NaHCO_3$
23.26	19.94	1.13	"
22.60	21.25	1.03	"
21.41	23.80	1.45	"

HCO

EQUILIBRIUM IN THE SYSTEM AMMONIUM BICARBONATE - AMMONIUM SULFATE - WATER

0° - (Belopolski, Shpunt, and Serebrenikova, 1934)
7° - (Belopolski and Shpunt, 1935)
-5° - (Belopolski and Shpunt, 1935a)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
$(NH_4)_2SO_4$	NH_4HCO_3			$(NH_4)_2SO_4$	NH_4HCO_3		
Results at 0°				Results at 7°			
41.26	0.28		A	42.0	0.0	-	A
39.93	0.65		A	39.27	2.58	-	A + B
39.49	0.56	1.234	A	30.91	3.73	-	B
39.05	1.36		A	23.58	5.26	-	B
39.30	1.23		A	13.09	7.74	-	B
38.38	2.37	1.228	A + B	0.0	13.65	-	B
36.96	2.19		B				
33.62	2.68	1.205	B	Results at -5°			
29.19	3.24		B				
24.0	4.25	1.153	B	15.00	-	-	Ice
18.15	5.22		B	40.80	-	-	A
13.31	6.16	1.160	B	38.22	1.72	1.214	A + B
11.39	6.85		B	29.41	2.73	-	B
8.21	7.76	1.071	B	17.93	4.34	-	B
6.01	8.29		B	9.86	5.36	-	B
				3.01	6.51	1.041	B + Ice

A = $(NH_4)_2SO_4$ B = NH_4HCO_3

Equilibrium data in the quaternary system NaCl - NH_4HCO_3 - H_2O were determined at 30° (10 and 40 atm.), 40° (10, 20, 40, 60 atm.), 50° (40 and 60 atm.), 60° (40 and 60 atm.), and 70° (40, 60, 70 atm.) by Utida, 1940.

AMMONIUM CARBAMATE $NH_4CO_2NH_2$

EQUILIBRIUM IN THE SYSTEM AMMONIUM CARBAMATE – AMMONIUM SULFATE – AMMONIA – WATER

(Schutze and Piechowicz, 1948)

t°	Moles per 1000 moles of Water			Solid Phase
	$NH_4CO_2NH_2$	$(NH_4)_2SO_4$	NH_3	
20	234	-	400	$NH_4CO_2NH_2$
	230	29	400	$NH_4CO_2NH_2 + (NH_4)_2SO_4$
	-	15.3	498	$(NH_4)_2SO_4$
30	283	-	285	$NH_4CO_2NH_2$
	279	35	285	$NH_4CO_2NH_2 + (NH_4)_2SO_4$
	-	41.3	331	$(NH_4)_2SO_4$
40	331	-	187	$NH_4CO_2NH_2$
	325	40	187	$NH_4CO_2NH_2 + (NH_4)_2SO_4$
	-	64.0	214	$(NH_4)_2SO_4$
50	382	-	100	$NH_4CO_2NH_2$
	375	45	100	$NH_4CO_2NH_2 + (NH_4)_2SO_4$
	-	83.8	138	$(NH_4)_2SO_4$
60	-	100.7	88	"
70	-	114.6	54	"
80	-	125.7	33	"

AMMONIUM OXALATE $(NH_4)_2C_2O_4$ CO

SOLUBILITY OF AMMONIUM OXALATE ABOVE 100°

(Beurath, 1942)

t°	114	130	144	157	171	186	195
Gms. $(NH_4)_2C_2O_4$ per 100 gms. Sat. Sol.	30	35	40	45	50	55	60

AMMONIUM CHLORIDE NH_4Cl Cl

Additional data on the solubility of NH_4Cl in water given by Polosin, 1946 agree excellently with those of previous workers (Vol. I, p. 1078).

SOLUBILITY OF AMMONIUM CHLORIDE IN AQUEOUS AMMONIA SOLUTIONS

(Alexandrov, 1941)

Gms. NH_3 per 100 gms. H_2O in Sat. Sol.	Gms. NH_4Cl per 100 gms. H_2O in Sat. Sol.							
	-20°	-10°	0°	10°	20°	30°	40°	50°
0	-	25.9	29.6	33.0	37.4	41.5	45.8	50.4
10	24.5	27.9	32.0	36.0	40.0	44.1	48.3	53.2
20	28.1	31.6	35.9	39.8	43.7	47.8	52.4	57.2
25	30.4	33.9	38.6	42.0	45.5	50.2	55.0	-
30	32.6	36.5	41.0	44.5	48.4	53.0	58.2	-
40	38.0	41.9	46.5	50.7	55.6	60.8	66.5	-

100 gms. of a solution saturated with both NH_3 and NH_4Cl at 25° contains 35.59 gms. NH_4Cl, 19.16 gms. NH_3. (Hill and Loucks, 1937).

SOLUBILITY OF AMMONIUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS

(Morozov and Ustavshikova, 1944, 1945)

The data were read from curves drawn by the authors.

Gms. HCl per 100 gms. Sat. Sol.	Gms. NH_4Cl per 100 gms. Sat. Sol.				
	0°	25°	50°	80°	100°
5	16	20	26.5	31.5	36
10	11	14	20.5	25	31
15	7.5	10.5	14.5	21	25
20	5.5	7.5	11	16.5	21.35*
27.5	-	-	-	11.52*	
30	3	4.5	7		
35	-	-	6.28*		
39.5	-	4.34*			
43.5	3.0*				

* Indicates the gms. NH_4Cl in a solution saturated with NH_4Cl and HCl, as given by the authors. All other figures were read from the curves drawn by the authors.

Cl

SOLUBILITY OF AMMONIUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 0°

(Seidel and Fischer, 1941)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.		Gms. per 100 Gms. Sat. Sol.	
HCl	NH_4Cl	HCl	NH_4Cl	HCl	NH_4Cl
0	22.9	27.3	2.21	37.3	2.32
13.2	8.02	32.3	2.00	39.7	2.55
16.9	5.37	33.8	2.01	42.4	3.15
20.7	3.61	36.8	2.24	44.8	4.17
23.0	2.81				

Data for the solubility of NH_4Cl in water saturated with CO_2 from 30° to 70° and from 10 to 70 atm. pressure is given by Utida, 1940.

Data for the reciprocal system $2NH_4Cl + H_2SO_4 \rightleftharpoons (NH_4)_2SO_4 + 2HCl$ in water at 25° is given by Blumberg and Zdanovskii, 1939.

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE - AMMONIUM IODIDE - WATER AT 25°

(Zhdanov, 1947)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4I	NH_4Cl		NH_4I	NH_4Cl		NH_4I	NH_4Cl	
0.0	28.20	C	24.82	17.88	C	37.65	13.42	C
3.88	26.25	C	25.56	17.46	C	39.68	12.84	C
6.31	25.29	C	28.14	16.51	C	40.21	12.71	C
7.93	24.58	C	29.91	16.10	C	44.68	10.98	C
10.60	23.85	C	31.14	15.39	C	47.83	9.75	C
14.41	22.22	C	33.85	14.76	C	51.07	8.66	C
17.11	20.84	C	34.52	14.35	C	54.43	7.74	C + I
18.94	20.52	C	36.55	13.42	C	54.93	7.53	C + I
22.37	19.06	C	37.25	13.36	C	56.10	7.30	C + I
						63.86	0.0	I

C = NH_4Cl I = NH_4I

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE - AMMONIUM NITRATE - WATER

(Pavlov, Bulovich, and Bergman, 1943)

Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4Cl	NH_4NO_3	
Results at -20°		
14.4	16.4	Cl + Ice
11.2	23.6	Ice
7.6	31.6	"
6.2	34.4	N + Ice
10.2	30.6	N
11.2	29.6	Cl + N
13	21.2	Cl
Results at 0°		
23	0	Cl
20.4	8	"
19.4	11.2	"
18.2	15.4	"
16.2	22.2	"
14	29.4	"
12.6	35	"
10.4	38.4	Cl + N
Results at 20°		
27.5	0	Cl
24.5	7.8	"
23.8	10.6	"
22.4	14.4	"
20	21.2	"
19.4	28	"
15.8	33.8	"
13	44	"
9.8	56	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4Cl	NH_4NO_3	
Results at -15°		
18.9	0	Ice
13.8	8.4	"
12.2	12	"
16.6	10	"
6	25	"
2.2	33.4	"
0	38.6	"
Results at 10°		
25.2	0	Cl
23.6	7.8	"
21.4	10.8	"
18.2	15.4	"
16	22.4	"
14.2	29.4	"
12.6	35	"
11	45	"
Results at 30°		
29.6	0	Cl
26.4	7.4	"
25.2	10.4	"
23.8	14	"
21.6	20.5	"
19.4	27.4	"
17.6	31.2	"
14.2	41.4	"
11	55.4	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4Cl	NH_4NC_3	
Results at -10°		
13.8	0	Ice
8.2	9.2	"
6.6	13	"
4	16.2	"
0	26.2	"
0	48.5	N
10.4	48.8	N + Cl
11.4	35.6	Cl
12.8	29.8	"
14.2	22.8	"
16.2	15.8	"
17	11.4	"
18.4	8	"
19	0	"
Results at -5°		
7.5	0	Ice
1.6	9.9	"
0	13	N

Cl

N = NH_4NO_3

Cl = NH_4Cl

COMPOSITION OF AMMONIA SOLUTIONS SATURATED WITH AMMONIUM CHLORIDE AND AMMONIUM NITRATE

(Alexandrov, 1946)

Gms. per 100 gms. H_2O			Density	Solid Phase
NH_3	NH_4Cl	NH_4NO_3		
		Results at -10°		
10.0	27.9	0.0	1.027	NH_4Cl
10.0	22.0	78.0	1.176	$NH_4Cl + NH_4NO_3$
10.0	0.0	96.0	1.197	NH_4NO_3
25.0	33.9	0.0	0.989	NH_4Cl
25.0	23.8	92.5	1.144	$NH_4Cl + NH_4NC_3$
25.0	0.0	114.5	-	NH_4NO_3
40.0	41.9	0.0	0.970	NH_4Cl
39.8	25.4	117.0	1.129	$NH_4Cl + NH_4NO_3$
40.0	0.0	141.0	1.142	NH_4NO_3

Data of Alexandrov, 1946 (Con.)

Gms. per 100 gms. H_2O			Density	Solid Phase
NH_3	NH_4Cl	NH_4NO_3		
		Results at 0°		
10.0	32.0	0.0	1.032	NH_4Cl
10.0	28.0	41.2	1.113	"
10.0	26.4	76.4	1.166	"
10.0	23.7	110.5	1.208	$NH_4Cl + NH_4NO_3$
10.0	0.0	128.0	1.224	NH_4NO_3
25.0	38.6	0.0	0.998	NH_4Cl
24.9	32.9	41.5	1.068	"
24.8	28.0	80.0	1.123	"
25.3	25.7	134.5	1.171	$NH_4Cl + NH_4NO_3$
25.0	0.0	149.5	1.186	NH_4NO_3
40.0	46.5	0.0	0.977	NH_4Cl
39.9	39.9	41.9	1.035	"
40.0	32.1	91.0	1.096	"
40.3	27.4	164.0	1.162	$NH_4Cl + NH_4NO_3$
40.0	0.0	180.0	1.167	NH_4NO_3
		Results at 20°		
10.0	40.0	0.0	1.040	NH_4Cl
10.0	35.1	49.9	1.130	"
10.0	29.7	146.0	1.243	"
10.1	29.2	185.5	1.270	$NH_4Cl + NH_4NO_3$
10.0	0.0	201.0	1.277	NH_4NO_3
25.0	45.5	0.0	1.000	NH_4Cl
25.0	38.7	50.3	1.081	"
25.0	32.7	151.0	1.194	"
24.9	31.0	216.0	1.242	$NH_4Cl + NH_4NO_3$
25.4	31.4	222.0	1.241	"
25.0	0.0	230.0	1.247	NH_4NO_3
40.0	55.2	0.0	0.975	NH_4Cl
40.0	40.0	101.6	1.105	"
40.1	34.1	204.5	1.193	"
40.6	33.7	263.0	1.220	$NH_4Cl + NH_4NO_3$
40.0	0.0	268.0	1.224	NH_4NO_3
		Results at 40°		
10.0	48.3	0.0	1.037	NH_4Cl
9.9	41.8	101.5	1.191	"
10.0	39.1	307.0	1.312	$NH_4Cl + NH_4NO_3$
10.0	39.1	305.0	1.316	"
10.0	0.0	315.0	1.312	NH_4NO_3
25.0	55.0	0.0	0.969	NH_4Cl
25.0	42.4	149.0	1.183	"
24.6	41.2	346.0	1.293	$NH_4Cl + NH_4NO_3$
25.2	41.5	352.0	1.286	"
25.0	0.0	353.0	1.275	NH_4NO_3
40.0	65.3	0.0	-	NH_4Cl
39.8	43.6	390.0	1.265	$NH_4Cl + NH_4NO_3$
40.0	0.0	405.0	1.260	NH_4NO_3

Cl

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE - AMMONIUM DIHYDROGEN PHOSPHATE - WATER

(Polosin, 1946)

Gms. per 100 gms. Sat. Sol.		Solid Phase
$NH_4H_2PO_4$	NH_4Cl	
	Results at -1.5°	
0.0	19.0	Ice
2.95	17.75	"
3.05	18.25	NH_4Cl
0.0	19.5	"
	Results at 0°	
18.6	0.0	$NH_4H_2PO_4$
12.3	4.38	"
8.6	9.14	"
5.2	15.17	"
3.9	19.22	"
3.5	21.3	NH_4Cl
0.0	22.8	"
	Results at 10°	
22.1	0.0	$NH_4H_2PO_4$
15.6	4.22	"
10.8	8.92	"
7.0	14.88	"
5.1	18.98	"
3.9	23.5	NH_4Cl
0.5	24.88	"
0.0	24.9	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
$NH_4H_2PO_4$	NH_4Cl	
	Results at 20°	
26.3	0.0	$NH_4H_2PO_4$
19.5	4.02	"
14.2	8.57	"
9.6	14.46	"
6.9	18.62	"
5.2	23.7	"
0.0	27.1	NH_4Cl
	Results at 25°	
29.2	0.0	$NH_4H_2PO_4$
21.7	3.91	"
16.2	8.38	"
11.1	14.22	"
8.1	18.38	"
6.1	23.48	"
0.0	28.2	NH_4Cl
	Results at 35°	
32.8	0.0	$NH_4H_2PO_4$
36.4	3.7	"
20.8	7.92	"
14.4	13.69	"
10.9	17.82	"
8.0	23.0	"
0.0	30.2	NH_4Cl

The eutectic temperature is -15.6° and the solution contains 3.9% $NH_4H_2PO_4$ and 17.8% NH_4Cl.

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE - AMMONIUM SULFATE - WATER AT 20°

(Doliqne and Pauc, 1947)

Gms. per 100 gms. H_2O		Density $\frac{20°}{4°}$	Solid Phase
NH_4Cl	$(NH_4)_2SO_4$		
37.4	0.0	1.076	C
35.58	7.7	1.100	C
33.8	13.52	1.113	C
32.33	20	1.134	C
31.05	39.2	1.179	C
26.97	48.52	1.191	C + S
21	54.05	1.202	S
9.9	64.74	1.223	S
0.0	73.95	1.245	S

C = NH_4Cl

S = Na_2SO_4

EQUILIBRIUM IN THE SYSTEM AMMONIUM CHLORIDE - SODIUM CHLORIDE - WATER

(Jarlykoff, 1934)

t°	Gms. per 100 gms. H_2O		Density	Solid Phase
	NaCl	NH_4Cl		
-10	33.06	0.0	1.1898	NaCl
	27.5	12.2	1.1785	NaCl + NH_4Cl
	14.9	18.45	1.1284	NH_4Cl
	0.0	26.3	1.060	"
0	35.2	0.0	1.2020	NaCl
	27.86	14.32	1.1788	NaCl + NH_4Cl
	17.80	19.28	1.1405	NH_4Cl
	0.0	29.9	1.066	"
10	35.3	0.0	1.1994	NaCl
	28.6	13.8	1.1788	"
	26.9	18.35	1.1719	NaCl + NH_4Cl
	16.7	23.7	1.1363	NH_4Cl
	0.0	33.2	1.072	"
20	35.6	0.0	1.201	NaCl
	34.4	2.74	1.1983	"
	28.7	15.5	1.1789	"
	25.8	21.5	1.1724	NaCl + NH_4Cl
	23.9	22.2	1.1591	NH_4Cl
	11.40	30.3	1.1181	"
	0.0	37.5	1.076	"
35	36.1	0.0	1.1910	NaCl
	23.9	27.7	1.1644	NaCl + NH_4Cl
	19.94	30.7	1.1490	NH_4Cl
	0.0	43.4	1.081	"
50	36.8	0.0	1.1900	NaCl
	34.2	5.75	1.1850	"
	30.2	11.5	1.1965	"
	31.02	15.0	1.1704	"
	23.9	33.0	1.1585	NaCl + NH_4Cl
	15.6	39.1	1.1415	NH_4Cl
	9.09	43.1	1.0876	"
	5.9	45.64	1.1243	"
	0.0	49.0	1.086	"
65	37.2	0.0	1.1920	NaCl
	25.2	30.5	1.1640	"
	20.69	42.7	1.1546	NaCl + NH_4Cl
	13.4	47.4	1.1243	NH_4Cl
	0.0	56.5	1.086	"
80	37.4	0.0	1.1926	NaCl
	36.7	1.63	1.1916	"
	19.7	50.7	1.1434	NaCl + NH_4Cl
	16.9	52.0	1.1415	NH_4Cl
	0.0	64.4	1.0876	"

Cl

Data for the system $NH_4H_2PO_4 + NaCl \rightleftharpoons NaH_2PO_4 + NH_4Cl$ in water at 25° are given by Lauffenburger, 1941.

Abe, Watanabe, and Hara, 1935 found the transition point between NH_4Cl and $NH_4Cl \cdot NH_3$ to occur at 5.9° with the saturated solution of NH_4Cl in liquid ammonia containing 118.98 gms. NH_4Cl per 100 gms. NH_3 at this temperature. The compound melts at 7.6°.

100 grams of a saturated solution of ammonium chloride in liquid SO_2 contain 0.0031 gms. NH_4Cl at 25°. (Shatenstein and Viktorov, 1937).

SOLUBILITY OF AMMONIUM CHLORIDE IN METHANOL SOLUTIONS AT 17°
(Mocalov, 1939)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
CH_3OH	NH_4Cl	CH_3OH	NH_4Cl
0.0	26.5	44.1	13.6
7.8	27.3	68.6	7.6
21.4	19.0	96.9	3.1

100 cc of a mixture of equal volumes of ethyl ether and water, saturated with HCl at 0° contain 0.159 gms. NH_4Cl upon saturation with the salt. (Fischer and Seidel, 1941).

AMMONIUM Platinum CHLORIDE $(NH_4)_2PtCl_6$ Cl

SOLUBILITY OF AMMONIUM CHLOROPLATINATE IN AQUEOUS SOLUTIONS AT 25°
(Belonogov, 1939)

Solvent:	Water	0.7% HCl	28.36% NH_4Cl	28.2% NH_4Cl + 0.7% HCl
Gms. $(NH_4)_2PtCl_6$ per 100 cc Solvent:	0.5530	0.5983	0.0082	0.0026

AMMONIUM Stannic CHLORIDE $(NH_4)_2SnCl_6$ Cl

SOLUBILITY OF AMMONIUM STANNIC CHLORIDE IN AQUEOUS SOLUTIONS OF NH_4Cl + HCl AT 0°
(Seidel and Fischer, 1941)

Each solution was saturated with HCl.

Gms. NH_4Cl per 100 cc at Start	Gms. per 100 cc Sat. Sol.		Gms. NH_4Cl per 100 cc at Start	Gms. per 100 cc Sat. Sol.	
	NH_4Cl	Sn		NH_4Cl	Sn
4.0	4.0	0.0004	1.0	1.0	0.0013
3.0	3.0	.0004	0.5	0.50	.005
2.0	2.0	.0006	0.0	0.11	.088

AMMONIUM Titanium CHLORIDE $(NH_4)_2TiCl_6$ Cl

SOLUBILITY OF AMMONIUM TITANIUM CHLORIDE IN SOLUTIONS OF AMMONIUM CHLORIDE AND HYDROCHLORIC ACID AT 0°
(Seidel and Fischer, 1941)

Gms. NH_4Cl per 100 cc at Start	Gms. per 100 cc Sat. Sol.		Gms. NH_4Cl per 100 cc at Start	Gms. per 100 cc Sat. Sol.	
	NH_4Cl	Ti		NH_4Cl	Ti
4.0	4.0	0.0005	1.0	1.0	0.0029
3.0	3.0	.0008	0.5	0.52	.0082
2.0	2.0	.0014	0.0	0.15	.065

ClO AMMONIUM PERCHLORATE $KClO_4$

SOLUBILITY OF AMMONIUM PERCHLORATE IN ORGANIC SOLVENTS AT 25°

(Semenchenko and Shakparonov, 1948)

Solvent	Moles NH_4ClO_4 per 100 moles Sat. Sol.	Solvent	Moles NH_4ClO_4 per 100 moles Sat. Sol.
$(CH_3)_2CO$	0.150	Iso-C_4H_9OH	0.010
n - C_3H_7CH	.026	CH_3OH	.440
C_2H_5OH	.130	H_2O	1.870

CrO AMMONIUM CHROMATE $(NH_4)_2CrO_4$

SOLUBILITY OF AMMONIUM CHROMATE IN WATER

(Hill, Soth, and Ricci, 1940a)

Solutions of the salt lose ammonia when exposed to the air. At 50° it was found that the % $(NH_4)_2CO_3$ in solution, based on a determination of NH_4^+, was 0.2% low after an hour's exposure of the solution to the open air and about 0.6% low after two hour's exposure. The loss of ammonia from the solid salt was negligible. Each result is the mean of a determination from supersaturation and one from undersaturation.

t°	Gms. $(NH_4)_2CrO_4$ per 100 gms. Sat. Sol.	t°	Gms. $(NH_4)_2CrO_4$ per 100 gms. Sat. Sol.
0	19.78	50	34.40
15	24.13	60	37.21
25	27.02	75	41.20
35	30.00		

F AMMONIUM FLUORIDE NH_4F

SOLUBILITY OF AMMONIUM FLUORIDE IN WATER

(Yatlov and Polyakova, 1945)

t°	Gms. NH_4F per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. NH_4F per 100 gms. Sat. Sol.	Solid Phase
-4.1	5.0	Ice	-16.8	41.0	$NH_4F \cdot H_2O + NH_4F$
-8.2	10.0	"	0	41.81	NH_4F
-12.1	15.0	"	10	42.55	"
-14.7	20.0	"	20	45.25	"
-20.7	25.0	"	30	47.05	"
-24.9	30.0	"	45	49.81	"
-26.5	32.3	Ice + $NH_4F \cdot H_2O$	60	52.62	"
-19.0	39.2	$NH_4F \cdot H_2O$	80	54.05	

SOLUBILITY OF AMMONIUM FLUORIDE IN WATER

(Spurgeon, 1941)

Temperature	5.6°	15.3°	20.9°	25°
Gms. NH_4F per 100 gms. H_2O	77.0	82.2	85.2	85.2

AMMONIUM FLUOBORATE NH_4BF_4 F

SOLUBILITY OF AMMONIUM FLUOBORATE IN WATER
(Yatlov and Pinayevskaya, 1945)

t°	Gms. NH_4BF_4 per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. NH_4BF_4 per 100 gms. Sat. Sol.	Solid Phase
-1.0	3.00	Ice	50.0	30.60	NH_4BF_4
-1.5	5.00	"	75.0	40.30	"
-2.7	9.79	Ice + NH_4BF_4	100.0	49.73	"
0.0	10.87	NH_4BF_4	*108.5	53.20	"
25.0	20.53	"			

*Boiling point at 748 mm.

AMMONIUM HYDROGEN FLUORIDE NH_4HF_2 F

SOLUBILITY OF AMMONIUM HYDROGEN FLUORIDE IN WATER
(Yatlov and Polyakova, 1945)

t°	Gms. NH_4HF_2 per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. NH_4HF_2 per 100 gms. Sat. Sol.	Solid Phase
-3.4	5.0	Ice	60	61.00	NH_4HF_2
-6.5	10.0	"	80	74.53	"
-9.4	15.0	"	100	85.55	"
-12.6	20.0	"	99.5	86.0	"
-14.8	23.6	Ice + NH_4HF_2	104.6	89.0	"
0	28.45	NH_4HF_2	110.5	92.0	"
10	31.96	"	114.0	94.0	"
20	37.56	"	126.1	100.0	"
40	50.05	"			

AMMONIUM FLUOSILICATE $(NH_4)_2SiF_6$ F

SOLUBILITY OF AMMONIUM FLUOSILICATE IN WATER
(Yatlov and Pinayevskaya, 1945)

Each point from 10° to 75° is the average of two determinations. Below 14° the stable phase was found to be β-$(NH_4)_2SiF_6$ regardless of whether the starting solid was β- or α-. Above 14° the α-$(NH_4)_2SiF_6$ is stable.

t°	Gms. $(NH_4)_2SiF_6$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $(NH_4)_2SiF_6$ per 100 gms. Sat. Sol.	Solid Phase
-1.3	5.00	Ice	15.0	15.61	α-$(NH_4)_2SiF_6$
-1.2	10.23	Ice + β-$(NH_4)_2SiF_6$	25.0	18.5	"
0.0	10.94	β-$(NH_4)_2SiF_6$	50.0	26.15	"
10.0	13.95	"	75.0	32.5	"
12.0	14.65	"	100.0	37.90	"
13.0	14.69	"	102.1*	38.18	"
14.0	15.50	β + $\alpha$$(NH_4)_2SiF_6$			

*Boiling point at 748 mm.

I AMMONIUM IODIDE NH_4I

FREEZING POINTS IN THE SYSTEM AMMONIUM IODIDE - WATER

(Briggs, Ballard, Alrich, and Wikswo, 1940)

t°	Wt. % NH_4I	t°	Wt. % NH_4I	t°	Wt. % NH_4I
0	0.0	-9	28.0	-21	47.7
-3	11.8	-13	35.8	-24	51.5
-6	20.7	-16	40.7	-27.4	55.5 (Eutectic)

EQUILIBRIUM IN THE SYSTEM AMMONIUM IODIDE - IODINE - WATER

(Briggs, Ballard, Alrich, and Wikswo, 1940)

Results at 0°

Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4I	I	
60.8	0.0	NH_4I
57.4	8.4	"
54.5	14.4	"
51.0	22.4	"
49.2	26.1	"
46.8	31.3	"
46.4	31.5	$NH_4I + NH_4I_3$
41.9	37.1	NH_4I_3
39.1	40.9	"
34.0	49.1	"
33.3	50.3	"
28.8	58.0	"
25.9	63.8	"
25.8	64.0	$NH_4I_3 + NH_4I_5$ (?)
25.8	63.9	NH_4I_5 (?)
25.0	64.2	"
24.1	65.4	NH_4I_5 (?) + I_2
24.0	64.9	I_2
23.8	61.4	"
23.5	56.4	"
23.3	52.7	"
22.2	45.6	"
17.4	27.6	"
12.2	15.0	"
3.5	2.9	"

Results at -15°

Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4I	I	
58.38	0.0	NH_4I
56.91	4.25	"
55.14	8.85	"
m53.96	11.23	"
m49.76	20.95	"
54.62	10.00	$NH_4I + NH_4I_3 \cdot 3H_2O$
50.55	9.91	$NH_4I_3 \cdot 3H_2O$
47.83	9.68	"
45.81	9.78	"
42.03	9.93	"
40.47	10.30	"
39.12	10.19	"
37.08	10.52	"
36.95	10.64	$NH_4I_3 \cdot 3H_2O$ + Ice
m31.74	34.38	Ice
m34.54	21.10	"
m36.30	13.63	"
m37.03	11.06	"
38.61	4.40	"
39.54	0.0	"

m = Metastable

t°	Gms. per 100 gms. Sat. Sol.		Solid Phase
	NH_4I	I	
-27.4	55.5	0	Ice + NH_4I
0	0	0.016	Ice + I_2
175	29.9	70.1	$NH_4I + NH_4I_3$
88.9	10.5	89.5	$NH_4I_3 + I_2$
114	0	100	I_2
-27.9	53.5	4.6	Ice + $NH_4I_3 \cdot 3H_2O$ + NH_4I
-8.3	23.2	52.5	Ice + $NH_4I_3 \cdot 3H_2O$ + I_2
-0.8	46.7	30.0	$NH_4I + NH_4I_3 \cdot 3H_2O + NH_4I_3$
2.4	25.1	64.6	$NH_4I_3 + NH_4I_3 \cdot 3H_2O + NH_4I_5$ (?)
0.2	23.9	65.4	$I_2 + NH_4I_3 \cdot 3H_2O + NH_4I_5$ (?)
9.8	23.2	68.8	$I_2 + NH_4I_3 + NH_4I_5$ (?)

The phase diagram for the system $NH_4I + I_2$ was determined by Briggs and Ballard, 1940.

Tetra Butyl AMMONIUM IODIDE $N(C_4H_9)_4I$ I

SOLUBILITY IN MIXTURES OF BENZENE AT 25°
(Vernon, Luder, and Giella, 1941)

Tetrabutyl Ammonium Picrate Added Moles per liter x 10^4	Moles $N(C_4H_9)I$ per liter x 10^4	Tetrabutyl Ammonium Nitrate Added Moles per liter x 10^4	Moles $N(C_4H_9)I$ per liter x 10^4
0.0	3.36	0.0	3.36
1.42	3.88	4.36	6.78
2.84	5.39	8.73	9.3
11.33	8.28	21.82	14.8
28.40	16.5	43.64	20.0
56.80	30.5		

AMMONIUM Sodium Rhodium NITRITE $(NH_4)_2Na[Rh(NO_2)_6]$ NO

SOLUBILITY IN WATER
(Petkov, 1949)

t°	Gms. $(NH_4)_2Na[Rh(NO_2)_6]$ per liter Sat. Sol.
10	0.94
20	1.47
25	2.09

AMMONIUM NITRATE NH_4NO_3 NO

SOLUBILITY OF AMMONIUM NITRATE IN WATER
(Shpunt, 1946)

Temperature of Crystallization	Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Solid Phase	Temperature of Crystallization	Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Solid Phase
-3.8	9.0	Ice	-5.5	50.0	NH_4NO_3
-7.0	16.6	"	-2.2	52.2	"
-9.3	23.0	"	+4.6	56.6	"
-11.5	28.6	"	10.5	60.0	"
-13.5	33.3	"	16.0	63.0	"
-15.3	37.5	"	21.2	65.8	"
-16.8	41.3	"	26.2	68.0	"
-3.2	44.6	NH_4NO_3	29.8	70.4	"
-9.4	47.4	"			

SOLUBILITY OF AMMONIUM NITRATE IN AQUEOUS AMMONIA SOLUTIONS

(Alexandrov, 1941)

Gms. NH_3 per 100 gms. H_2O in Sat. Sol.	Gms. NH_4NO_3 per 100 gms. H_2O in Sat. Sol.							
	-20°	-10°	0°	10°	20°	30°	40°	50°
0	-	89.5	118	150	186	235	296	355
10	69	96	128	161	201	253	315	373
20	80	106	138	174	218	273	337	405
25	88	114.5	149.5	185	230	287	353	420
30	96	123.5	158.5	198	242	303	370	438
40	110	141	180	221	268	333	405	477

The densities and partial pressures of solutions of ammonium nitrate in aqueous ammonia were determined at 10° and 35° by Schultz and Elmore, 1946.

NO

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE - AMMONIUM DIHYDROGEN PHOSPHATE - WATER

(Bergman and Botchkareff, 1937)

Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.	Solid Phase
	Results at -10°	
27.2	0	Ice
22	5.5	Ice + $NH_4H_2PO_4$
28.8	3.8	$NH_4H_2PO_4$
38.9	2.4	"
45	2	"
45.6	1.8	NH_4NO_3 + $NH_4H_2PO_4$
47	0	NH_4NO_3
	Results at 10°	
0.0	21.4	$NH_4H_2PO_4$
8.4	15.5	"
18	10	"
23.5	7.7	"
28.1	6.2	"
38.2	4.1	"
44.6	3	"
48.8	2.2	"
54.1	1.6	"
58	1.2	NH_4NO_3 + $NH_4H_2PO_4$
59.6	0.0	NH_4NO_3
	Results at 30°	
0.0	30.2	$NH_4H_2PO_4$
7.8	22.7	"
16.9	15.1	"
26.9	10.3	"
37.5	6.2	"
43.9	4.5	"
48.2	8.5	"
53.5	2.7	$NH_4H_2PO_4$
58.8	2	"
68.7	1.2	NH_4NO_3 + $NH_4H_2PO_4$
69.7	0.0	NH_4NO_3
	Results at 0°	
0	18.4	$NH_4H_2PO_4$
8.8	12.4	"
18.3	8.2	"
28.6	4.8	"
38.7	3.1	"
44.9	2.4	"
49	1.9	"
51.2	1.5	NH_4NO_3 + $NH_4H_2PO_4$
53.6	46.4	NH_4NO_3
	Results at 20°	
0.0	25.5	$NH_4H_2PO_4$
8.1	18.8	"
17.5	12.2	"
27.6	8.1	"
30.5	7	"
37.9	5.1	"
44.3	3.7	"
48.6	9.8	"
53.8	2.2	"
59	1.6	"
64	1.2	NH_4NO_3 + $NH_4H_2PO_4$
65.1	0.0	NH_4NO_3

Additional Data:

t°	Gms. NH_4NO_3 per 100 gms. Sat. Sol.	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.	Solid Phase
-4.4	0.0	17.4	Ice + $NH_4H_2PO_4$
-4.6	2.7	14.1	"
-6.3	9	10.4	"
-6.9	12	8.8	"
-9.0	18.6	6.6	"
-12.9	29.0	3.6	"
-15.9	39.1	2.2	"
-11	45.2	1.8	NH_4NO_3 + $NH_4H_2PO_4$
-3.2	49.2	1.6	"
5.2	54.2	1.3	"
11.4	59.3	1.3	"
-16.4	42.7	0.0	Ice + NH_4NO_3
-16.3	41.1	1.0	"
-16.8	40.3	2.1	Ice + NH_4NO_3 + $NH_4H_2PO_4$

Results at 50°

(Kuznetsov, Kozhukhovskii, and Borovaya, 1948)

77.0	0.0	NH_4NO_3
75.6	1.4	"
74.4	2.5	$NH_4H_2PO_4$
68.9	3.3	"
55.6	7.6	"
45.6	10.7	"
42.3	11.8	"
27.9	20.3	"
21.8	25.3	"
13.3	32.2	"
0.0	47.05	"

The partial pressures of NH_3 and H_2O at 50° are also given.

Data for the system NH_4NO_3 + $NH_4H_2PO_4$ + H_2O at 20° and 70° are given by Loginova, 1938.

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE - AMMONIUM SULFATE - WATER

(Sokolov, 1988)

Results at 0°

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$(NH_4)_2SO_4$	NH_4NO_3		$(NH_4)_2SO_4$	NH_4NO_3	
0.0	54.2	A	21.95	29.3	D + B
3.26	51.3	A	26.65	24.0	B
8.34	47.5	A	29.75	18.9	B
10.12	46.1	A + C	32.6	13.2	B
15.2	37.6	C	35.5	7.9	B
17.8	34.6	C	37.9	4.74	B
20.5	31.8	C	39.6	2.30	B
17.4	35.1	C + D	45.5	0.0	B
20.4	31.6	D			

Data of Sokolov, 1938 (Con.)

Results at 25°

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$(NH_4)_2SO_4$	NH_4NO_3		$(NH_4)_2SO_4$	NH_4NO_3	
0.0	67.8	A	9.6	55.0	D*
2.2	66.1	A	12.5	50.0	D
4.1	64.1	A	15.1	45.8	D
4.7	63.6	A + C	15.7	44.6	D + B
5.3	61.4	C	21.2	34.7	B
7.4	58.2	C	25.1	27.7	B
8.5	56.2	C	29.9	20.1	B
10.5	53.0	C + D	33.3	14.6	B
7.2	59.3	D*	43.5	0.0	B

NO

Results at 40°

0.0	73.5	A	15.8	46.8	B
1.8	72.0	A	21.2	35.9	B
3.2	70.8	A + C	25.8	28.5	B
4.2	67.8	C	30.7	20.7	B
7.3	62.4	C + D	34.1	14.4	B
9.9	58.2	D	44.8	0.0	B
11.6	54.7	B + D			

* = Metastable A = NH_4NO_3 B = $(NH_4)_2SO_4$
C = $3NH_4NO_3 \cdot (NH_4)_2SO_4$ D = $2NH_4NO_3 \cdot (NH_4)_2SO_4$

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE - AMMONIUM SULFATE - WATER AT 25°

(Bahl and Singh, 1941)

Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_4NO_3	$(NH_4)_2SO_4$	
68.17	0.0	NH_4NO_3
65.43	2.25	"
64.10	3.95	$NH_4NO_3 + (NH_4)_2SO_4 \cdot 3NH_4NO_3$
61.50	4.56	"
59.54	6.24	$(NH_4)_2SO_4 \cdot 3NH_4NO_3$
57.62	7.51	$(NH_4)_2SO_4 \cdot 3NH_4NO_3 + (NH_4)_2SO_4 \cdot 2NH_4NO_3$
55.78	8.46	$(NH_4)_2SO_4 \cdot 2NH_4NO_3$
51.41	10.83	"
47.95	13.58	$(NH_4)_2SO_4 \cdot 2NH_4NO_3 + (NH_4)_2SO_4$
45.47	14.92	$(NH_4)_2SO_4$
32.14	22.21	"
15.21	32.97	"
0.0	43.43	"

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE - SODIUM NITRATE - WATER

(Shpunt, 1946)

Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. NH_4NO_3	Solid Phase
Results at -20°		
11.1	34.6	NH_4NO_3 + Ice
15.1	29.8	Ice
18.3	26.6	"
20.2	24.0	"
24.4	18.6	"
31.1	10.4	"
35.6	5.4	$NaNO_3$ + Ice
33.4	10.2	$NaNO_3$
28.6	21.6	"
25.8	28.4	$NaNO_3$ + NH_4NO_3
20.9	30.4	NH_4NO_3 "
16.6	32.8	"
Results at -10°		
39.8	-	$NaNO_3$
35.5	9.8	"
30.8	20.8	"
25.2	33.4	$NaNO_3$ + NH_4NO_3
23.6	34.0	NH_4NO_3 "
19.0	36.6	"
18.5	36.8	"
8.5	48.1	"
-	47.2	"
23.1	-	Ice
10.7	13.4	"
9.8	14.4	"
8.2	16.4	"
-	24.6	"
Results at 20°		
46.0	-	$NaNO_3$
42.3	8.8	"
37.4	18.9	"
27.1	38.3	"
23.8	46.7	"
22.8	49.0	$NaNO_3$ + NH_4NO_3
20.5	50.6	NH_4NO_3 "
13.1	55.6	"
5.6	61.4	"
-	65.2	"
Results at -17.2°		
38.4	-	$NaNO_3$ + Ice
33.9	10.0	$NaNO_3$
29.2	21.4	"
25.6	29.6	$NaNO_3$ + NH_4NO_3
20.4	32.0	NH_4NO_3 "
17.0	33.8	"
9.4	37.2	"
-	42.3	NH_4NO_3 + Ice
10.3	30.6	Ice
14.4	25.8	"
26.4	12.0	"
27.2	11.0	"
Results at 0°		
41.9	-	$NaNC_3$
37.9	9.5	"
32.9	20.2	"
25.5	36.8	"
24.5	38.7	$NaNO_3$ + NH_4NO_3
20.8	40.8	NH_4NO_3 "
17.2	43.1	"
7.6	48.7	"
-	53.6	"
Results at 30°		
48.0	-	$NaNO_3$
44.6	8.4	"
42.2	14.89	"
39.6	18.3	"
34.4	29.68	"
28.2	40.8	"
26,98	43.78	"
24.5	48.2	"
21.5	54.3	$NaNO_3$ + NH_4NO_3
16.81	57.68	NH_4NC_3 "
11.59	61.10	"
11.2	62.2	"
7.28	64.86	"
4.7	67.4	"
-	70.5	"

The eutectic temperature is -25.7° and the saturated solution contains 25.4% NH_4NO_3 and 25.7% $NaNO_3$.

For data on the solubility of NH_4NO_3 in KH_2PO_4 and KNO_3 solutions see p. 320.

COMPOSITION OF SOLUTIONS SATURATED WITH BOTH AMMONIUM AND SODIUM NITRATES

(Schloesing, 1920)

t°	Gms. per 100 gms. Sat. Sol.		t°	Gms. per 100 gms. Sat. Sol.	
	NH_4NO_3	$NaNO_3$		NH_4NO_3	$NaNO_3$
140	73.1	26.4	40	57.5	21.0
117	78.0	21.1	16.1	47.4	22.6
95	74.0	20.0	0.2	39.1	24.1
60	64.4	20.2	-15.4	32.0	27.1

Vapor pressures in the system NH_4NO_3 - $NaNO_3$ - $Pb(NC_3)_2$ - H_2O have been determined by Dingemans and Dijkgraaf, 1949.

The vapor pressures of saturated solutions in the system NH_4NO_3 - $Pb(NO_3)_2$ - H_2O have been measured by Dingemans, 1945.

NO

SOLUBILITY OF AMMONIUM NITRATE IN ETHANOL SOLUTIONS

(Thompson and Vener, 1948)

Composition of solvents:

Number	Density at 35°	Wt. % C_2H_5OH	Mole % C_2H_5OH
10	0.99714	9.82	4.09
20	.96150	19.90	8.86
30	.94424	29.89	14.29
50	.90191	49.90	28.03
70	.85510	69.83	47.51
82	.82511	82.08	64.17
88	.80995	88.03	74.20
92	.79769	92.63	83.09

Results are in gms. NH_4NO_3 per 100 gms. Saturated Solution
Densities are in gms. per ml. in Vacuo

H_2O	Solvent Number					
	10	20	30	50	70	92
			— 25° —			
	65.45	60.90	56.38	43.50	26.05	7.29
	1.2859	1.2532	1.2110	1.1052	0.9758	0.8382
			— 30° —			
69.86	67.46	63.73	59.37	46.90	29.16	8.07
1.3295	1.2968	1.2669	1.2265	1.1222	0.9882	0.8377
			— 35° —			
71.84	69.40	66.22	62.25	50.26	32.27	8.88
1.3376	1.3063	1.2790	1.2413	1.1380	1.0007	0.8374
			— 40° —			
73.58	71.34	68.59	64.89	53.51	35.36	9.72
1.3449	1.3160	1.2904	1.2546	1.1535	1.0134	0.8372
			— 45° —			
75.35	73.24	70.89	67.27	56.55	38.48	10.63
1.3520	1.3428	1.3014	1.2667	1.1688	1.0267	0.8372
			— 50° —			
76.99	75.10	73.11	69.57	59.49	41.63	11.65
1.3586	1.3331	1.3121	1.2784	1.1842	1.0406	0.8375

Data of Thompson and Vener, 1948 (Con.)

Solvent Number						
H_2O	10	20	30	50	70	92
			— 55° —			
78.61	76.90	75.27	71.79	62.39	44.92	12.75
1.3653	1.3410	1.3222	1.2908	1.1996	1.0561	0.8379
			— 60° —			
80.14	78.68	77.34	73.97	65.20	48.39	13.91
1.3713	1.3489	1.3322	1.3032	1.2143	1.0724	0.8385
			— 65° —			
81.72	80.41	79.18	76.11	67.94	51.93	15.24
1.3768	1.3565	1.3418	1.3159	1.2276	1.0888	0.8400
			— 70° —			
83.20	82.12	80.71	78.22	70.65		16.69
1.3818	1.3641	1.3513	1.3286	1.2402		0.8435
			— 75° —			
84.56	83.81	81.75	80.30	73.33		18.19
1.3872	1.3716	1.3608	1.3413	1.2524		0.8407

NO

Additional Data

Solvent Number	Temperature			
	60°	65°	70°	75°
82	29.73	32.98	36.24	-
	0.9434	0.9576	0.9718	-
88	19.98	22.36	24.74	27.12
	0.8795	0.8848	0.8902	0.8954

Data for the Two Phase Region

t°	Upper Phase			Lower Phase		
	Wt. % NH_4NO_3 in Sat. Sol.	Density of Sat. Sol.	Wt. % C_2H_5OH in Solvent	Wt. % NH_4NO_3 in Sat. Sol.	Density of Sat. Sol.	Wt. % C_2H_5OH in Solvent
66.91	46.60	1.0479	76.3	60.75	1.1594	65.9
69.01	42.89	1.0180	78.9	64.95	1.1972	60.3
70.41	40.53	0.9995	80.4	67.29	1.2129	56.8
71.84	39.21	.9875	81.4	69.39	1.2229	54.7
73.98	37.67	.9700	82.7	72.41	1.2341	51.9

SOLUBILITY OF AMMONIUM NITRATE IN ISOPROPANOL SOLUTIONS

(Thompson and Molstad, 1945)

Solvents:

Number	7	10	87	93	95
Density at 35°	0.98186	0.97726	0.80358	0.78924	0.78382
Wt. % i-C_3H_7CH	7.01	9.96	87.60	93.43	95.58
Mole % i-C_3H_7OH	2.21	3.21	67.94	81.01	86.63

Data of Thompson and Molstad, 1945 (Con.)

Solubilities in gms. NH_4NO_3 per 100 gms. Saturated Solution
Densities in gms. per ml. in Vacuo

t°	Solvent					
	H_2O	7	10	87	93	95
30	69.86	67.65	66.69	8.70	4.57	3.23
	1.3295	1.3079	1.2996	0.8461	0.8162	0.8025
35	71.84	69.74	68.99	9.52	5.01	3.47
	1.3376	1.3173	1.3097	0.8453	0.8130	0.7993
40	73.58	71.76	71.10	10.37	5.50	3.81
	1.3449	1.3255	1.3187	0.8444	0.8099	0.7962
45	75.35	73.71	73.10		6.01	4.19
	1.3520	1.3332	1.3272		0.8070	0.7930
50	76.99	75.55	75.60		6.53	4.59
	1.3586	1.3406	1.3354		0.8044	0.7902
55	78.61	77.29	76.81		7.07	5.00
	1.3653	1.3478	1.3434		0.8021	0.7872
60	80.14	79.01	78.50		7.66	5.45
	1.3713	1.3548	1.3509		0.8005	0.7848
65	81.72	80.65	80.26		8.29	5.90
	1.3768	1.3619	1.3581		0.7999	0.7830
70	83.20	82.26	81.97		8.97	6.37
	1.3818	1.3690	1.3650		0.7995	0.7817
75	84.56	83.79	83.51			6.89
	1.3872	1.3754	1.3717			0.7806

NO

Two-Phase Data

t°	Upper Layer			Lower Layer		
	Wt. % NH_4NC_3 in Sat. Sol.	Density Saturated Solution	Wt. % Alcohol in Solvent	Wt. % NH_4NO_3 in Sat. Sol.	Density Saturated Solution	Wt. % Alcohol in Solvent
30	11.32	0.8638	84.5	66.44	1.2840	14.5
35	10.89	.8542		67.90	1.2964	
40	10.56	.8456	87.4	70.12	1.3072	14.7
45	10.31	.8380		72.25	1.3171	
50	10.11	.8305	89.5	74.20	1.3269	15.3
55	9.96	.9234		75.99	1.3360	
60	9.83	.8167	91.3	77.70	1.3442	16.6
65	9.72	.8102		79.39	1.3504	
70	9.62	.8038	92.8	81.09	1.3552	18.3
75	9.52	.7990		82.81	1.3604	

100 gms. of a saturated solution of ammonium nitrate in furfural contain 0.4 gms. NH_4NO_3 at 25°. (Trimble, 1941)

EQUILIBRIUM IN THE SYSTEM AMMONIUM NITRATE - UREA - WATER

(Sokolov, 1939)

The system was studied from the eutectic to 25° and a diagram is drawn which shows the equilibrium phases at 5° intervals. The compositions of solutions in equilibrium with more than one solid phase are given below:

t°	Gms. per 100 gms. Sat. Sol. $CO(NH_2)_2$	Gms. per 100 gms. Sat. Sol. NH_4NO_3	Solid Phase	t°	Gms. per 100 gms. Sat. Sol. $CO(NH_2)_2$	Gms. per 100 gms. Sat. Sol. NH_4NO_3	Solid Phase
-16.65	0.0	43.10	Ice + B	-19.6	31.3	20.6	D + E
-11.1	32.9	0.0	Ice + D	-23.5	29.2	26.8	Ice + D + E
-14.0	32.7	6.8	Ice + D	+16.2	49.2	5.0	E + F
-20.7	30.1	20.9	Ice + D	+0.5	40.5	17.9	E + F
-18.5	7.7	41.0	Ice + A + B	-25.5	28.4	31.7	Ice + E + F
-18.5	30.5	39.5	A + B + F	-13.4	32.2	41.5	F + B
-25.9	28.4	35.9	A + F	+6.6	36.8	47.4	F + B
*-26.5	29.8	35.1	Ice + A + F	+12.0	25.7	53.5	B + C
+9.5	37.6	48.3	B + C + F	+10.0	35.6	49.2	B + C
-7.4	36.4	6.4	D + E				

NO

* = Eutectic

A = α - NH_4NO_3 D = α - $CO(NH_2)_2$
B = β - NH_4NO_3 E = β - $CO(NH_2)_2$
C = γ - NH_4NO_3 F = γ - $CO(NH_2)_2$

Melting point data are given for the following systems:

NH_4NO_3 + $NaNO_3$ (Holmes and Revinson, 1944)(Jänecke, 1949)
NH_4NO_3 + $(NH_4)_2SO_4$ (Nikonova and Bergman, 1942)
NH_4NO_3 + $NH_4SO_3NH_2$ (Thelin and van der Meulen, 1948)
NH_4NO_3 + $Ca(NO_3)_2$ (Clark and Esterbrook, 1949)
NH_4NO_3 + $Ca(NO_3)_2$ + Guanidine Nitrate (Clark and Esterbrook, 1948)
NH_4NO_3 + $LiNO_3$ + Guanidine Nitrate (Clark and Esterbrook, 1948)
NH_4NO_3 + $NaNO_3$ + Guanidine Nitrate (Clark and Esterbrook, 1948)
NH_4NO_3 + Guanidine Nitrate (Urbanski and Skrzynecki, 1936)
NH_4NO_3 + Nitro Guanidine (Urbanski and Skrzynecki, 1936)
NH_4NO_3 + Aniline Hydrochloride (Klug and Pardee, 1945)
NH_4NO_3 + Aniline Nitrate (Klug and Pardee, 1945)
NH_4NO_3 + Methylamine Hydrochloride (Klug and Pardee, 1945)
NH_4NO_3 + Mannitol (Khayshbashev, 1945)
NH_4NO_3 + Resorcinol (Khayshbashev, 1945)
NH_4NO_3 + Urea (Khayshbashev, 1945)
NH_4NO_3 + Acetamide (Khayshbashev, 1945)
NH_4NO_3 + p - Phenylenediamine (Khayshbashev, 1945)
NH_4NO_3 + o - Phenylenediamine (Khayshbashev, 1945)
NH_4NO_3 + Picric Acid (Khayshbashev, 1945)
NH_4NO_3 + Cholesterol (Khayshbashev, 1945)
NH_4NO_3 + Trinitrotoluene (Khayshbashev, 1945)

Melting points have been determined by Campbell and Campbell for the following systems[1947]:

NH_4NO_3 + Trinitrotoluene
" + $NaNO_3$
" + $NaNO_3$ + KNO_3
" + $LiNO_3$
" + $LiNO_3$ + $NaNO_3$
" + $Cd(NO_3)_2$
NH_4NO_3 + $Ba(NO_3)_2$
" + $Ba(NO_3)_2$ + $NaNO_3$
" + $Pb(NO_3)_2$
" + Urea
" + $NaNO_3$ + Urea
" + $NaNO_3$ + Urea Nitrate
" + Ethylene Diamine Dinitrate

MoO **AMMONIUM MOLYBDATE $(NH_4)_2MoO_4$**

100 gms. of a saturated solution of ammonium molybdate in furfural contain 0.4 gms. $(NH_4)_2MoO_4$ at 25°. (Trimble, 1941).

PO **AMMONIUM PHOSPHATES** $(NH_4)_3PO_4$ $(NH_4)_2HPO_4$ $NH_4H_2PO_4$

EQUILIBRIUM IN THE SYSTEM AMMONIA - PHOSPHORIC ACID - WATER

(Brosheer and Anderson, 1946)

A solid phase was found to exist at 60° and 75° which was previously unreported. The composition [C, below] was determined by wet-residue analysis.

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NH_3	H_3PO_4		NH_3	H_3PO_4	
		Results at 75°			
6.70	73.56	A	14.34	58.19	A
6.67	72.85	A	14.39	58.41	A
6.75	63.86	A	14.61	58.55	A
6.87	58.11	A	14.89	59.23	A + B
6.98	54.81	A	14.70	56.85	B
7.02	54.67	A	14.47	53.04	B
7.25	43.79	A	14.24	49.93	B
7.23	47.96	A	13.82	46.48	B
7.48	45.25	A	13.58	43.66	B
7.71	44.42 a	A	13.38	41.53	B
7.81	44.54	A	13.42	39.13	B
7.80	44.68	A	13.38	38.69 b	B
8.11	44.91	A	7.08	85.49	A
8.20	45.11	A	6.85	80.35	A
8.53	45.31	A	6.72	75.24	A
9.22	47.02	A	13.55	38.46	B + C
9.27	47.17	A	12.88	35.61	C
9.60	47.93	A	12.47	33.02	C
9.72	48.05	A	12.08	29.57	C
9.90	48.13	A	11.91	27.16	C
10.54	49.73	A	11.98	25.74	C
11.09	51.06	A	11.83	22.60	C
11.34	51.61	A	11.94	20.86	C
11.52	52.00	A	12.15	14.96	C
12.07	53.25	A	13.47	8.86	C
12.50	54.07	A	15.40	5.36	C
13.04	55.05	A	20.47	1.92	C
13.14	55.79	A	23.73	1.09	C
14.10	57.68	A			
		Results at 60°			
12.74	41.24	B	12.62	35.69	B + C
12.36	37.96	B	12.64	35.61	B + C
12.45	36.76	B	11.72	31.13	C
12.54	35.90	B	11.04	25.98	C

A = $NH_4H_2PO_4$ B = $(NH_4)_2HPO_4$ C = $(NH_4)_3PO_4 \cdot 2(NH_4)_2HPO_4$

a = Solubility of $NH_4H_2PO_4$ in water b = Solubility of $(NH_4)_2HPO_4$ in water

SOLUBILITY OF AMMONIUM PHOSPHATES IN AMMONIA SOLUTIONS

(Mouromtzev and Nazarova, 1938)

Gms. per 100 gms. Sat. Sol.		Moles per 100 moles Sat. Sol.		Solid Phase
NH_3	H_3PO_4	$(NH_4)_2O$	P_2O_5	
		Results at 0°		
23.71	0.07	16.45	0.009	A
16.48	0.15	10.44	.017	A
13.88	0.23	8.53	.025	A
7.85	0.62	4.53	.062	A
3.22	1.88	1.78	.180	A
2.26	3.10	1.25	.30	A
2.41	5.24	1.35	.51	A
3.65	9.65	2.14	.98	A
7.14	19.92	4.70	2.28	A
7.78	21.81	5.25	2.56	A
8.18	22.92	5.59	2.72	A
8.35	23.50	5.75	2.81	A
9.34	26.56	6.68	3.30	A + B
9.97	32.35	7.57	4.27	B
10.12	33.26	7.78	4.43	B
10.71	37.84	8.68	5.32	B
11.14	41.06	9.37	6.00	B + C
8.60	33.76	6.49	4.43	C
6.32	27.02	4.26	3.24	C
3.89	19.37	2.45	2.12	C
3.52	17.98	2.19	1.94	C
3.07	16.61	1.88	1.76	C
2.85	18.69	1.76	2.01	C
2.90	21.19	1.83	2.32	C
3.00	23.25	1.94	2.73	C
3.52	61.96	3.24	9.94	C
3.50	69.46	3.52	12.10	C + D
3.54	71.09	3.64	12.69	D
3.25	71.80	3.35	12.85	D
2.70	74.54	2.85	13.62	D
2.96	77.00	3.24	14.65	D
2.82	79.22	3.17	15.44	D
3.40	83.93	4.14	17.68	D
3.52	84.55	4.33	18.06	E
2.92	86.36	3.63	18.65	F
1.71	82.93	1.97	16.59	F
		Results at 25°		
4.31	34.09	3.08	4.22	C
4.25	27.20	2.86	3.18	C
4.18	25.09	2.77	2.89	C
4.34	24.46	2.87	2.80	C
4.48	24.92	2.95	2.87	C
4.93	25.94	3.32	3.03	C
8.55	36.50	6.62	4.91	C
5.22	81.40	6.38	17.27	C + E
3.27	87.44	4.17	19.40	E
2.90	88.93	3.74	20.11	E

PO

Data of Mouromtzev and Nazarova, 1938 (Con.)

Gms. per 100 gms. Sat. Sol.		Moles per 100 moles Sat. Sol.		Solid Phase
NH_3	H_3PO_4	$(NH_4)_2O$	P_2O_5	
		Results at 50°		
12.26	3.01	7.56	0.321	A
9.35	8.80	5.82	0.951	A
8.97	14.10	5.78	1.58	A
9.33	18.05	6.23	2.09	A
11.18	29.02	8.40	3.79	A
11.49	30.96	8.83	4.13	A
12.20	34.10	9.75	4.73	A + B
12.03	34.71	9.65	4.83	B
12.00	34.81	9.61	4.85	B
12.03	35.52	9.73	4.98	B
12.07	36.07	9.82	5.09	B
12.28	38.67	10.41	5.70	B
12.64	42.35	11.05	6.43	B + C
13.88	53.20	14.01	9.32	C
8.50	40.42	6.81	5.63	C
6.68	35.63	4.99	4.63	C
6.10	34.58	4.48	4.41	C
5.84	35.51	4.31	4.55	C
5.77	41.88	4.50	5.68	C
5.68	54.77	5.03	8.43	C
5.97	71.92	6.50	13.62	C
6.48	83.03	8.36	18.60	C
6.44	85.33	8.60	19.80	C + E
5.88	88.06	8.09	21.07	E

A = $(NH_4)_3PO_4 \cdot 3H_2O$
B = $(NH_4)_2HPO_4$
C = $NH_4H_2PO_4$
D = $NH_4H_5(PO_4)_2 \cdot H_2O$
E = $NH_4H_5(PO_4)_2$
F = $2H_3PO_4 \cdot H_2O$

PO AMMONIUM PHOSPHATE $(NH_4)_3PO_4$

17.7 gms. $(NH_4)_3PO_4$ dissolve in 100 gms. of water at 25°. (Ross, Merz, and Jacob, 1929).

PO AMMONIUM Mono HYDROGEN PHOSPHATE $(NH_4)_2HPO_4$

SOLUBILITY IN WATER
(Janecke, 1927)

t°	Gms. $(NH_4)_2HPO_4$ per 100 gms. Sat. Sol.	t°	Gms. $(NH_4)_2HPO_4$ per 100 gms. Sat. Sol.
10	38.6	40	45.0
20	40.8	50	47.2
25	41.0*	60	49.3
30	42.9	70	51.5

*Ross, Merz, and Jacob, 1929

EQUILIBRIUM IN THE SYSTEM AMMONIUM HYDROGEN PHOSPHATE - AMMONIUM SULFATE - WATER

(Chernova and Korzh, 1946)

t°	Gms. per 100 gms. Sat. Sol.		Solid Phase	t°	Gms. per 100 gms. Sat. Sol.		Solid Phase
	$(NH_4)_2HPO_4$	$(NH_4)_2SO_4$			$(NH_4)_2HPO_4$	$(NH_4)_2SO_4$	
0	27.80	7.80	$(NH_4)_2HPO_4 \cdot 2H_2O$	10	16.40	28.90	$(NH_4)_2HPO_4$
	22.20	15.80	"		16.00	31.60	
	17.50	25.00	"		0.0	42.40	$(NH_4)_2SO_4$
	14.00	30.00	"	20	34.20	6.90	$(NH_4)_2HPO_4$
	13.20	32.10	"		27.40	14.70	"
	0.0	41.60	$(NH_4)_2SO_4$		21.20	23.80	"
10	30.40	7.90	$(NH_4)_2HPO_4 \cdot 2H_2O$		18.60	28.20	"
	24.20	15.50	"		17.80	30.80	"
	19.80	24.10	$(NH_4)_2HPO_4$		0.0	43.60	$(NH_4)_2SO_4$

AMMONIUM DIHYDROGEN PHOSPHATE $NH_4H_2PO_4$ PO

SOLUBILITY OF AMMONIUM DIHYDROGEN PHOSPHATE IN WATER

The solubility between 0° and 110° was determined by Buchanan and Winner (1920), (Vol. I, p. 1116) and by Janecke (1927) with identical results. The data of Ross, Merz, and Jacob (1929) are considerably higher than these above 70°, and are about 1 - 2% (absolute) lower below 40° Between 0° and 40° the solubility has been determined by Bergman and Botchkareff (1938), Shpunt (1941), Belchew and Bergman (1944), Polosin (1946), and Polosin and Shakhparonov, 1947 with fairly good agreement among the various data. The results were plotted, and the average curve drawn through the points was about 1% lower than that of Buchanan and Winner over the same temperature interval. The solubilities of Bergman and Botchkareff are the lowest of all. All investigators except Ross, Merz, and Jacob agree on the solubility at 0°.

Data for the ice curve are included by Bergman and Botchkareff, Belchew and Bergman, Shpunt, Polosin, and Polosin and Ozolin (1940). Those of Shpunt are about 0.4° lower than the others at the same concentrations. These results were also plotted and the eutectic was determined graphically.

t°	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.
	Average of Bergman, Polosin, et al
-1.0	4.0
-2.0	8.1
-3.0	12.3
-4.0	16.6
*-4.2	17.4

*Eutectic

PO

t°	Gms. $NH_4H_2PO_4$ per 100 gms. Sat. Sol.		
	Average of Bergman, et al, Polosin, et al, and Shpunt	Average of Buchanan and Winner and Janecke	Average of Ross, Merz, and Jacob
0	18.4	18.5	16.6
5	20.1	20.6	19.1
10	21.9	22.8	21.7
15	24.0	25.0	24.0
20	26.1	27.2	26.35
25	28.3	29.4	28.57
30	30.5	31.7	31.2
35	32.8	33.8	33.5
40		36.3	36.0
50		40.9	
60		45.2	45.5
70		50.0	
80		54.2	57.1
90		58.9	
100		63.4	81.4
110.5		68.3	

EQUILIBRIUM IN THE SYSTEM AMMONIUM DIHYDROGEN PHOSPHATE - AMMONIUM SULFATE - WATER

(Belchew and Bergmann, 1944)

Gms. per 100 gms. Sat. Sol.		Solid Phase
$(NH_4)_2SO_4$	$NH_4H_2PO_4$	
Results at -10°		
29.4	0.0	Ice
27.2	2.8	"
24.0	6.0	"
22.2	7.6	$NH_4H_2PO_4$
28.1	6.3	"
36.1	4.8	"
37.8	4.6	$NH_4H_2PO_4 + (NH_4)_2SO_4$
39.1	2.4	$(NH_4)_2SO_4$
40.4	0.0	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
$(NH_4)_2SO_4$	$NH_4H_2PO_4$	
Results at -5°		
16.7	0.0	Ice
14.4	3.4	"
11.6	7.0	"
9.0	10.0	"
6.0	13.7	Ice + $NH_4H_2PO_4$
8.7	12.7	$NH_4H_2PO_4$
18.0	9.6	"
28.1	7.2	"
36.1	5.4	"
38.0	5.2	$NH_4H_2PO_4 + (NH_4)_2SO_4$
39.6	2.4	$(NH_4)_2SO_4$
40.8	0.0	"

Data of Belchew and Bergmann, 1944 (Con.)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$(NH_4)_2SO_4$	$NH_4H_2PO_4$		$(NH_4)_2SO_4$	$NH_4H_2PO_4$	
Results at 0°			Results at 10°		
0.0	18.8	$NH_4H_2PO_4$	0.0	22.2	$NH_4H_2PO_4$
8.6	14.7	"	8.2	17.4	"
17.8	10.7	"	17.3	13.4	"
27.6	8.0	"	27.0	10	"
35.7	5.9	"	35.0	7.6	"
38.0	5.4	$NH_4H_2PO_4 + (NH_4)_2SO_4$	38.2	6.9	$NH_4H_2PO_4 + (NH_4)_2SO_4$
38.5	5.0	$(NH_4)_2SO_4$	39.6	4.9	$(NH_4)_2SO_4$
40.0	2.4	"	41.0	2.4	"
41.2	0.0	"	42.0	0.0	"
Results at 20°			Results at 30°		
0.0	26.0	$NH_4H_2PO_4$	0.0	30.6	$NH_4H_2PO_4$
7.8	21.3	"	7.4	25.2	"
16.6	16.6	"	16.1	20.1	"
26.3	12.1	"	25.4	15.4	"
34.3	9.5	"	33.2	12.0	"
38.5	8.3	$NH_4H_2PO_4 + (NH_4)_2SO_4$	38.4	10.2	$NH_4H_2PO_4 + (NH_4)_2SO_4$
40.5	4.8	$(NH_4)_2SO_4$	40.2	7.2	$(NH_4)_2SO_4$
41.9	2.3	"	41.8	4.7	"
42.9	0.0	"	43.1	2.3	"
			43.7	0.0	"

Data for the ternary systems $NH_4H_2PO_4 - (NH_4)_2SO_4 - H_2O$ from 0° to 100° and $NH_4H_2PO_4 - H_3PO_4 - H_2O$ at 25° and 75° and for part of the quaternary system $NH_4H_2PO_4 - (NH_4)_2SO_4 - H_3PO_4 - H_2O$ at 25° and 70° are given by Uno, 1940a.

Data for the quaternary system KCl + $NH_4H_2PO_4 - H_2O$ from the eutectic to 35° are reported by Polosin and Shakhparonov, 1940.

Data for the system $KH_2PO_4 - NH_4H_2PO_4 - H_2O$ at many temperatures are given by Polosin and Ozolin, 1940.

EQUILIBRIUM IN THE SYSTEM AMMONIUM DIHYDROGEN PHOSPHATE - SODIUM DIHYDROGEN PHOSPHATE - WATER

(Shpaut, 1941)

The eutectic temperature is -12.1° with the solution containing 8.0% $NH_4H_2PO_4$ and 26.6% NaH_2PO_4.

Gms. per 100 gms. Sat. Sol.		Solid Phase
$NH_4H_2PO_4$	NaH_2PO_4	
	Results at -9.9°	
0.0	42.4	Ice + $NaH_2PO_4 \cdot 2H_2O$
3.6	28.6	Ice
7.5	24.6	"
9.2	22.8	Ice + $NH_4H_2PO_4$
8.5	28.4	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
3.4	30.4	$NaH_2PO_4 \cdot 2H_2O$
	Results at -7°	
0.0	24.2	Ice
4.0	21.0	"
8.4	17.4	"
12.3	13.8	Ice + $NH_4H_2PO_4$
10.6	20.8	$NH_4H_2PO_4 \cdot 2H_2O$
8.8	29.4	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
7.0	29.7	$NaH_2PO_4 \cdot 2H_2O$
3.4	31.5	"
0.0	33.6	"
	Results at -4.3°	
0.0	15.1	Ice
8.8	7.0	"
16.8	0.0	$NH_4H_2PO_4$ + Ice
15.3	6.6	$NH_4H_2PO_4$
13.3	13.5	"
11.4	20.6	"
9.1	30.3	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
6.9	31.0	$NaH_2PO_4 \cdot 2H_2O$
3.3	32.8	"
0.0	34.6	"
	Results at 0°	
18.4	0.0	$NH_4H_2PO_4$
16.9	6.4	"
16.06	9.02	"
14.7	13.1	"
13.11	18.46	"
12.9	20.0	"
10.53	27.47	"
10.0	31.1	"
9.64	31.69	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
9.8	31.7	"
6.7	33.2	$NaH_2PO_4 \cdot 2H_2O$
5.8	33.5	"
3.2	34.8	"
2.62	34.84	"
0.0	36.4	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
$NH_4H_2PO_4$	NaH_2PO_4	
	Results at 10°	
21.8	0.0	$NH_4H_2PO_4$
20.5	6.2	"
18.0	12.7	"
16.1	19.4	"
12.7	30.2	"
11.5	34.1	"
11.1	35.5	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
6.2	38.0	$NaH_2PO_4 \cdot 2H_2O$
3.0	39.5	"
0.0	40.5	"
	Results at 20°	
25.9	0.0	$NH_4H_2PO_4$
24.2	5.7	"
21.4	12.1	"
19.5	18.9	"
15.8	29.2	"
14.5	32.9	"
13.4	36.7	"
12.4	39.1	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
5.7	42.9	$NaH_2PO_4 \cdot 2H_2O$
2.8	44.2	"
0.0	45.3	"
	Results at 30°	
30.2	0.0	$NH_4H_2PO_4$
28.0	5.5	"
26.10	9.77	"
25.2	11.5	"
23.0	18.2	"
20.0	24.97	"
18.6	28.2	"
17.3	31.9	"
16.2	35.4	"
15.78	35.62	"
13.30	41.89	$NH_4H_2PO_4$ + $NaH_2PO_4 \cdot 2H_2O$
13.20	41.60	"
9.55	43.75	$NaH_2PO_4 \cdot 2H_2O$
6.26	46.50	"
5.2	47.8	"
3.42	48.55	"
2.5	49.0	"
0.0	51.2	"

EQUILIBRIUM IN THE SYSTEM AMMONIUM DIHYDROGEN PHOSPHATE - SODIUM NITRATE - WATER

(Shpunt, 1947)

Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. $NH_4H_2PO_4$	Solid Phase
	Results at -10°	
23.1	0.0	Ice
19.2	4.9	"
18.6	6.5	"
16.7	8.3	"
13.5	13.1	Ice + $NH_4H_2PO_4$
17.4	12.6	$NH_4H_2PO_4$
26.6	10.9	"
33.9	9.8	$NH_4H_2PO_4$ + $NH_4H_2PO_4 \cdot 2H_2O$
34.4	9.6	$NH_4H_2PO_4 \cdot 2H_2O$ + $NaNO_3$
36.3	6.5	$NaNO_3$
37.6	3.8	"
39.8	0.0	"
	Results at +10°	
0.0	21.8	$NH_4H_2PO_4$
7.9	20.8	"
16.2	18.6	"
17.2	16.1	"
34.5	13.8	"
37.5	12.8	$NH_4H_2PO_4$ + $NaNO_3$
41.4	5.9	$NaNO_3$
42.5	3.5	"
43.9	0.0	"
	Results at +30°	
0.0	30.2	$NH_4H_2PO_4$
7.2	28.0	"
15.2	24.4	"
23.6	21.3	"
32.6	18.4	"
35.5	17.3	"
39.0	16.1	"
40.0	15.5	$NH_4H_2PO_4$ + $NaNO_3$
46.2	5.4	$NaNO_3$
47.4	3.1	"
48.0	0.0	"
	Results at +60°	
0.0	43.8	$NH_4H_2PO_4$
11.24	37.57	"
23.21	31.15	"
34.2	26.1	"
42.97	22.27	$NH_4H_2PO_4$ + $NaNO_3$
44.93	18.90	$NaNO_3$
47.8	14.39	"
50.04	8.72	"
55.55	0.0	"
	Results at +110°	
0.0	67.3	$NH_4H_2PO_4$
26.27	50.8	"
43.33	39.74	$NH_4H_2PO_4$ + $NaNO_3$
57.28	16.88	$NaNO_3$
65.7	0.0	"
	Results at 0°	
0.0	18.4	$NH_4H_2PO_4$
8.2	17.1	"
12.15	16.03	"
16.7	15.5	"
24.58	14.08	"
25.8	13.7	"
36.36	11.92	$NH_4H_2PO_4$ + $NaNO_3$
36.4	12.0	"
38.8	6.3	$NaNO_3$
39.24	5.69	"
40.0	3.60	"
41.9	0.0	"
	Results at +20°	
0.0	25.9	$NH_4H_2PO_4$
7.6	24.1	"
15.7	21.6	"
18.65	21.1	"
24.4	18.8	"
33.7	16.0	"
36.5	15.0	"
37.50	14.52	"
38.86	14.5	$NH_4H_2PO_4$ + $NaNO_3$
40.87	10.03	$NaNO_3$
43.8	5.6	"
44.56	4.38	"
45.2	3.2	"
46.0	0.0	"
	Results at +40°	
0.0	34.3	$NH_4H_2PO_4$
6.72	31.07	"
14.69	27.93	"
30.55	21.44	"
41.48	17.19	$NH_4H_2PO_4$ + $NaNO_3$
42.2	15.97	$NaNO_3$
45.15	10.07	"
48.3	5.05	"
51.3	0.0	"
	Results at +80°	
0.0	53.6	$NH_4H_2PO_4$
15.08	44.05	"
30.0	35.7	"
43.28	28.02	$NH_4H_2PO_4$ + $NaNO_3$
51.60	14.94	$NaNO_3$
56.47	7.30	"
59.68	0.0	"

SOLID SOLUTIONS IN THE SYSTEM AMMONIUM DIHYDROGEN PHOSPHATE - THALLIUM DIHYDROGEN PHOSPHATE - WATER AT 29.5°

(Bruzau, 1948)

Gms. per 100 gms. Sat. Sol.		Density	Gms. TlH_2PO_4 in solid phase
TlH_2PO_4	$NH_4H_2PO_4$		
0.0	30.87	1.174	0.0
2.52	29.86	1.197	7.49
4.90	29.03	1.217	14.81
9.02	27.10	1.257	25.41
*15.35	25.10	1.321	41.52
21.00	22.10	1.381	49.08
23.85	21.66	1.416	56.94
26.79	20.04	1.453	59.16
28.25	19.63	1.472	60.18
30.45	16.13	1.479	96.66
30.97	11.92	1.448	98.22
33.56	5.16	1.425	98.72
33.94	0.0	1.394	100

*at 30°

PO

EQUILIBRIUM IN THE SYSTEM AMMONIUM DIHYDROGEN PHOSPHATE - UREA - WATER

(Blidin, 1941a)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NH_4H_2PO_4$	$CO(NH_2)_2$		$NH_4H_2PO_4$	$CO(NH_2)_2$	
Results at -10°			Results at 15°		
14.5	17.2	$NH_4H_2PO_4$	21.2	15.8	$NH_4H_2PO_4$
14.4	25.5	"	22.6	7.9	"
10.1	32.8	α-$CO(NH_2)_2$	20.1	24.0	"
7.0	32.5	"	16.8	37.3	"
			18.1	33.0	"
Results at 0°			5.2	45.9	α-$CO(NH_2)_2$
			8.1	45.5	"
17.1	16.2	$NH_4H_2PO_4$	11.2	45.1	"
18.4	7.8	"			
16.2	25.0	"	Results at 25°		
14.9	34.0	"			
9.6	37.8	α-$CO(NH_2)_2$	25.1	15	$NH_4H_2PO_4$
8.9	37.2	"	26.3	7.4	"
			24.0	22.8	"
Results at 5°			19.1	36.0	"
			21.6	31.3	"
18.5	16.1	$NH_4H_2PO_4$	4.8	51.6	α-$CO(NH_2)_2$ + β-$CO(NH_2)_2$
19.6	8.0	"	7.3	50.5	"
17.9	26.0	"	10.2	49.5	"
15.8	33.9	"			
12	40.9	α-$CO(NH_2)_2$			
6	40.1	"			

The eutectic occurs at -16° with the solution containing 12.8% $NH_4H_2PO_4$ and 28.6% $CO(NH_2)_2$.

AMMONIUM PERRHENATE NH_4ReO_4 ReO

SOLUBILITY OF AMMONIUM PERRHENATE IN WATER

(Smith and Long, 1948)

t°	Moles NH_4ReO_4 per 100 gms. H_2O
0	0.0103
30	.0325
50.3	.0599

AMMONIUM SULFITE $(NH_4)_2SO_3$ SO

EQUILIBRIUM IN THE SYSTEM AMMONIA - SULFUR DIOXIDE - WATER AT 25°

(Hill, 1948)

The system was studied in the concentration range where the total pressure was less than one atmosphere. Only slight oxidation to sulfate occurred, and the solid phase was $(NH_4)_2SO_3 \cdot H_2O$ throughout. The solubility of ammonium sulfite read from the plot of these data is several percent less than that found by Ishikawa and Murooka (Vol. I, p. 1120).

Gms. per 100 gms. Sat. Sol.			Density d_{15}^{25}	Gms. per 100 gms. Sat. Sol.			Density d_{15}^{25}
NH_3	SO_2	SO_3		NH_3	SO_2	SO_3	
23.8	6.5	0.2	0.964	12.1	21.0	-	-
19.9	9.3	-	1.007	11.5	22.0	0.3	1.201
17.4	13.5	nil	1.061	11.8	27.3	0.2	1.234
16.1	15.9	0.3	1.101	12.4	33.3	0.3	1.278
15.8	16.4	0.1	1.109	13.4	41.4	0.8	1.342
13.8	19.0	nil	-	13.8	43.2	0.2	1.358
13.8	19.2	0.1	1.150	14.1	44.9	0.4	1.371
11.9	20.7	0.7	-	14.8	49.2	0.5	1.411

Additional results for the system NH_3-SO_2-H_2O at 0°, 20°, 30°, 40°, 50° and 60° are given by Terres and Hahn, 1927. Their results differ from the above in solutions containing less than 20% SO_2.

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFITE - AMMONIUM BISULFITE - WATER

(Vasilenko, 1949)

t°	Gms. per 100 gms. Sat. Sol.		Solid Phase
	$(NH_4)_2SO_3$	NH_4HSO_3	
0	31.71	0.0	$(NH_4)_2SO_3 \cdot H_2O$
	22.58	19.50	"
	15.40	39.17	"
	10.78	56.29	"
	9.06	60.76	$(NH_4)_2SO_3 \cdot H_2O + (NH_4)_2S_2O_5$
	7.20	63.99	$(NH_4)_2S_2O_5$
	2.48	69.18	"
	0.0	72.38*	"

Data of Vasilenko, 1949 (Con.)

t°	Gms. per 100 gms. Sat. Sol. $(NH_4)_2SO_3$	Gms. per 100 gms. Sat. Sol. NH_4HSO_3	Solid Phase
20	37.40	0.0	$(NH_4)_2SO_3 \cdot H_2O$
	30.24	13.99	"
	24.26	27.75	"
	18.19	42.50	"
	14.79	54.54	"
	11.31	65.04	$(NH_4)_2SO_3 \cdot H_2O + (NH_4)_2S_2O_5$
	9.73	67.56	$(NH_4)_2S_2O_5$
	6.48	70.57	"
	4.61	71.27	"
	3.54	73.84	"
SO	1.71	74.26	"
	0.0	75.95**	"
30	40.30	0.0	$(NH_4)_2SO_3 \cdot H_2O$
	30.77	18.81	"
	21.99	38.26	"
	16.13	55.94	"
	12.75	66.73	$(NH_4)_2SO_3 \cdot H_2O + (NH_4)_2S_2O_5$
	8.21	70.98	$(NH_4)_2S_2O_5$
	4.09	74.45	"
	1.72	76.85	"
	0.0	79.31	"

*Contained excess H_2SO_3 = 0.59 Wt. % **Contained excess H_2SO_3 = 1.31 Wt. %
***Contained excess H_2SO_3 = 0.58 Wt. %

COMPOSITIONS OF SOLUTIONS SATURATED WITH AMMONIUM SULFITE AND BISULFITE

t°	Gms. per 100 gms. Sat. Sol. $(NH_4)_2SO_3$	Gms. per 100 gms. Sat. Sol. NH_4HSO_3	Solid Phase	
0	13.54	54.16	$(NH_4)_2SO_3 \cdot H_2O + NH_4HSO_3$	(Terres and Hahn, 1927)
20	16.13	54.00	"	(" " " ")
25	11.59	66.88	$(NH_4)_2SO_3 + (NH_4)_2S_2O_5$	(Ishikawa and Hagisawa, 1933)
40	27.42	44.85	$(NH_4)_2SO_3 \cdot H_2O + NH_4HSO_3$	(Terres and Hahn, 1927)
60	34.04	40.59	"	(" " " ")

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFITE - SODIUM CHLORIDE - WATER

(Silberman and Ivanov, 1941)

t°	Gms. per 100 gms. Sat. Sol. Na_2SO_3	$(NH_4)_2SO_3$	NaCl	NH_4Cl	Solid Phase
60	-	-	11.96	25.30	$NH_4Cl + NaCl$
	-	35.82	-	16.74	$(NH_4)_2SO_3 \cdot H_2O + NH_4Cl$
	2.36	-	24.23	-	$NaCl + Na_2SO_3$
	8.35	45.08	-	-	$(NH_4)_2SO_3 \cdot H_2O + Na_2SO_3$
	12.84	0.52	-	30.84	$Na_2SO_3 + NH_4Cl + NaCl$
	4.25	35.11	-	15.79	$Na_2SO_3 + (NH_4)_2SO_3 \cdot H_2O + NH_4Cl$

Data of Silberman and Ivanov, 1941 (Con.)

t°	Gms. per 100 gms. Sat. Sol. Na_2SO_3	$(NH_4)_2SO_3$	NaCl	NH_4Cl	Solid Phase
80	2.27	-	26.08	-	Na_2SO_3 + NaCl
	-	-	11.57	29.94	NaCl + NH_4Cl
	5.51	54.67	-	-	Na_2SO_3 + $(NH_4)_2SO_3$
	-	43.18	-	18.46	$(NH_4)_2SO_3$ + NH_4Cl
	6.31	27.80	-	20.00	Na_2SO_3 + NH_4Cl
	4.78	34.63	-	19.91	"
	4.91	41.22	-	18.34	Na_2SO_3 + $(NH_4)_2SO_3$ + NH_4Cl
	13.40	-	-	15.79	Na_2SO_3 + NH_4Cl + NaCl

AMMONIUM BISULFITE NH_4HSO_3 SO

SOLUBILITY OF AMMONIUM BISULFITE IN WATER

(Vasilenko, 1948)

Solid Phase Ice		Solid Phase $(NH_4)_2S_2O_5$			
t°	Gms. NH_4HSO_3 per 100 gms. Sat. Sol.	t°	Gms. NH_4HSO_3 per 100 gms. Sat. Sol.	t°	Gms. NH_4HSO_3 per 100 gms. Sat. Sol.
-3.4	9.4	-24.8	63.6	4.6	73.5
-6.0	16.8	-21.7	64.4	5.1	73.1
-8.7	22.7	-21.0	65.0	13.8	75.6
-10.2	27.5	-16.7	66.3	15.7	76.6
-12.2	30.9	-17.0	66.4	*20.0	74.5
-13.8	34.9	-13.8	67.9	**20.0	76.95
-16.6	40.3	-10.0	68.4	***25.0	78.41
-18.9	44.5	-9.2	69.5	*40.0	80.3
-21.5	48.5	-3.3	70.7	**40.0	80.64
-24.2	51.3	-4.0	71.2	*60.0	86.1
-25.0	53.2	-0.2	72.3	**60.0	84.7
-26.2	54.4	*0.0	72.8		
-29.0	57.8	**0.0	71.8		
-29.0	59.1				
-31	60.5				

*Terres and Hahn (1937) **Terres and Heinsen (1937)
***Ishikawa and Hagisawa (1933)

EQUILIBRIUM IN THE SYSTEM AMMONIUM BISULFITE - AMMONIUM SULFATE - WATER

(Vasilenko, 1948)

The solubility of ammonium sulfate was redetermined, and the results agree with those found by previous authors (Vol. I, p. 1122). The data below were determined by the polythermal method.

Gms. per 100 gms. Sat. Sol. $(NH_4)_2SO_4$	Gms. per 100 gms. Sat. Sol. NH_4HSO_3	Solid Phase
Results at 20°		
42.8	0.0	A
36.5	9.6	A
29.0	21.3	A
21.5	34.2	A
13.3	52.0	A
10.3	58.1	A
9.9	58.1	A
9.4	60.7	A
8.0	65.5	A
7.30	66.8	A
6.9	68.6	A
5.9	71.2	A
6.0	71.8	A + B
0.0	77.0	B
Results at 0°		
41.0	0.0	A
34.5	9.9	A
26.5	22.1	A
19.5	35.1	A
12.8	50.3	A
10.0	56.3	A
9.1	59.1	A
8.9	58.8	A
7.9	64.2	A
7.4	65.3	A + B
6.6	65.6	B
3.0	69.3	B
2.0	70.6	B
0.0	72.0	B
Results at -10°		
40.0	0.0	A
35.5	10.0	A
25.5	22.4	A
18.5	35.5	A
12.5	49.1	A
9.9	55.4	A
9.0	58.1	A
8.4	59.2	A
8.0	60.8	A + B
Results at -10° (Con.)		
7.6	61.8	B
6.3	62.5	B
2.9	66.3	B
0.0	68.7	B
28.0	0.0	Ice
13.5	13.1	Ice
0.0	26.0	Ice
Results at -19°		
39.25	0.0	Ice + A
32.5	10.2	A
24.5	22.7	A
17.7	35.9	A
12.4	48.7	A
9.7	54.6	A
8.8	57.2	A
8.8	57.1	A + B
7.2	58.9	B
6.0	60.0	B
3.8	62.1	B
2.8	63.6	B
0.0	65.5	B
0.0	44.5	Ice
1.0	43.1	Ice
8.4	33.0	Ice
16.3	25.1	Ice
30.0	10.5	Ice
Results at -31°		
0.0	60.5	Ice + B
2.6	59.0	B
5.7	56.2	B
6.7	54.8	B
9.4	52.9	B
9.8	52.0	A + B
12.5	45.5	Ice + A
8.7	49.0	Ice
6.3	51.3	Ice
5.3	53.0	Ice
2.5	56.6	Ice

The eutectic temperature is -34.5° (10.0% $(NH_4)_2SO_4$, 50.5% NH_4HSO_3).

A = $(NH_4)_2SO_4$ B = NH_4HSO_3

EQUILIBRIUM IN THE SYSTEM AMMONIUM BISULFITE - SODIUM CHLORIDE - WATER

(Silberman and Ivanov, 1941)

t°	Gms. per 100 gms. Sat. Sol.				Solid Phase
	$NaHSO_3$	NH_4HSO_3	NaCl	NH_4Cl	
25	21.10	-	16.94	-	$NaHSO_3$ + NaCl
	6.43	65.57	-	-	$NaHSO_3 + NH_4HSO_3$
	-	67.47	-	3.81	NH_4HSO_3 + NaCl
	27.48	-	1.24	17.84	$NaHSO_3$ + NH_4Cl + NaCl
	7.61	62.04	-	2.98	$NH_4HSO_3 + NaHSO_3$ + NH_4Cl
	-	-	16.82	16.16	$NaCl + NH_4Cl$
60	27.56	-	15.44	-	$NaHSO_3$ + NaCl
	-	61.80	-	12.28	NH_4HSO_3 + NH_4Cl
	6.34	74.50	-	-	$NaHSO_3 + NH_4HSO_3$
	23.34	14.40	-	19.41	$NaHSO_3$ + NH_4Cl + NaCl
	5.43	50.19	-	12.62	$NaHSO_3 + NH_4HSO_3$ + NH_4Cl
	-	-	11.96	25.30	NH_4Cl + NaCl

The system $(NH_4)_2SO_3 - (NH_4)_2S_2O_3 - H_2O$ at 25° has been studied by Terres and Overdick, 1928. Results are also given in the presence of excess SO_2.

AMMONIUM SULFATE $(NH_4)_2SO_4$ SO

Equilibrium data in the system $NH_3 - SO_3 - H_2O$ between 0° and 100° is reported by Terres and Schmidt, 1927. The solubility of $(NH_4)_2SO_4$ in the presence of excess NH_3 and SO_3 was determined.

SOLUBILITY OF AMMONIUM SULFATE IN AMMONIA SOLUTIONS AT 25°

(Hill and Loucks, 1937)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
NH_3	$(NH_4)_2SO_4$	NH_3	$(NH_4)_2SO_4$
0	43.41	21.39	15.68
12.84	26.80	22.62	13.97
18.33	19.31	23.34	13.42

SOLUBILITY OF AMMONIUM SULFATE IN AMMONIA SOLUTIONS

(Guyer, Bieler, and Orelli, 1940)

The results are presented in the form of diagrams only, and the following data were read from the curves: (Gms. $(NH_4)_2SO_4$ per 100 gms. of solvent)

% NH_3 in Solvent	-30°	-10°	0°	23°
5	24	-	22	26
10	18	14 (15% NH_3)	14	21
20	8	5	4.5	16
30	2.5	1.5	3	11
40	1	1	2.5	7
60			2	2.5
80			1.5	1.5

The solubility of ammonium sulfate in aqueous ammonia solutions from 5° to 35° was determined by Belopolskii, Lebedev, and Trifonova, 1931.

EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFATE - SODIUM SULFATE - WATER

° - (Belopolskii and Shpunt, 1936)
-5° - (Belopolskii and Shpunt, 1935a)
0° - (Belopolskii, Shpunt, and Serebrenikova, 1934)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
Na_2SO_4	$(NH_4)_2SO_4$			Na_2SO_4	$(NH_4)_2SO_4$		
Results at 0°				Results at 7° (Con.)			
6.56	8.80	-	A	10.60	25.77	-	A + B
6.86	16.43	1.158	A	8.52	29.48	-	B
7.22	23.46	1.204	A	6.82	33.73	-	B
7.66	28.60	1.233	A + B	5.63	37.74	-	B + C
7.25	29.77	-	B	0.0	42.0	-	C
6.33	30.76	1.239	B				
5.52	33.59	-	B	Results at -5°			
4.43	37.84	1.243	B + C				
3.0	38.80	-	C	4.53	13.79	1.119	A + Ice
1.54	40.07	-	C	6.08	32.67	1.233	A + B
Results at 7°				4.08	38.20	1.253	B + C
				0.0	40.80	1.226	C
7.55	0.0	-	A	0.0	15.0	-	C + Ice
8.70	10.96	-	A				
9.64	19.36	-	A				

A = $Na_2SO_4 \cdot 10H_2O$ B = $Na_2SO_4 \cdot (NH_4)_2SO_4 \cdot 4H_2O$ C = $(NH_4)_2SO_4$

Data for the system $(NH_4)_2SO_4 - H_3PO_4 - H_2O$ at 25° and 75° are given by Uno, 1940a.

Data for the quaternary system $(NH_4)_2SO_4 - Na_2SO_4 - NH_3 - H_2O$ from 0° to 25° are given by Belopolskii and Aleksandrov, 1933.

The phase diagram for the system $(NH_4)_2SO_4$ - Pyridine - Water at 25° is given by Peakin, 1940, but without numerical data. The ammonium sulfate decreases the solubility of pyridine in water to a minimum of about 22% when the saturated solution contains 15% salt.

SO AMMONIUM PERSULFATE $(NH_4)_2S_2O_8$

SOLUBILITY OF AMMONIUM PERSULFATE IN SULFURIC ACID AND AMMONIUM SULFATE SOLUTIONS

(Gall, Church, and Brown, 1943)

It was found that solutions of the persulfate decomposed upon standing to yield H_2SO_5 and $(NH_4)_2SO_4$ and that H_2O_2 was then produced. The amount of H_2SO_5 and H_2O_2 present at varying lengths of time were determined and an extrapolation was then made to zero time in order to find the amount of undecomposed persulfate originally present. The authors present their original data, and the following rounded values read from plots of the data. Densities are also given.

Gms. $(NH_4)_2S_2O_8$ per Liter of Saturated Solution

Gms. H_2SO_4 per liter Sat. Sol.	Gms. $(NH_4)_2SO_4$ per liter Sat. Sol.				
	0	25	50	75	100
	Results at 15°				
0	520*	496	474	451	428
50	448	428	408	389	369
100	388	370	352	335	318
150	334	318	303	286	271
200	288	274	258	242	227
250	247	233	218	203	190
300	212	197	182	166	154
350	178	162	148	132	120
400	145	132	116	101	88
	Results at 20°				
0	542**	518	496	475	452
50	481	461	441	421	401
100	426	406	390	371	352
150	374	356	340	324	307
200	326	310	295	278	263
250	281	265	250	235	219
300	239	224	208	194	178
350	190	183	169	155	139
400	162	146	131	116	100

*density = 1.254 **density = 1.266

100 parts of water dissolve 65 parts of $(NH_4)_2S_2O_8$ at room temperature. (Elbs, 1893).

100 gms. of a saturated solution of ammonium persulfate in furfural contain 0.1 gms. $(NH_4)_2S_2O_8$ at 25°. (Trimble, 1941).

AMMONIUM SULFAMATE $NH_4SO_3NH_2$ SON

SOLUBILITY OF AMMONIUM SULFAMATE IN WATER

(Cupery, 1938; Ricci and Selikson, 1947)

The anhydrous salt is the solid phase (R. and S.)

t°	Gms. $NH_4SO_3NH_2$ per 100 gms.		t°	Gms. $NH_4SO_3NH_2$ per 100 gms.	
	H_2O	Sat. Sol.		H_2O	Sat. Sol.
0.2	134.8	58.4	30	232.4	70.0
10	166.6	62.5	35*	265.3	72.9
20	200.2	66.7	40	279.5	73.7
20*	203.0	67.0	50	357	78.1
25*	221.5	68.87			

*Ricci and Selikson.

SON EQUILIBRIUM IN THE SYSTEM AMMONIUM SULFAMATE - SULFAMIC ACID - WATER AT 25°

(Ricci and Selikson, 1947)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NH_4SO_3NH_2$	HSO_3NH_2		$NH_4SO_3NH_2$	HSO_3NH_2	
68.87	0.0	$NH_4SO_3NH_2$	60.72	15.26	HSO_4NH_2
65.99	5.73	"	47.39	16.19	"
63.59	11.00	"	29.89	17.06	"
62.96	13.65	"	12.18	17.72	"
62.19	15.16	$NH_4SO_3NH_2 + HSO_3NH_2$	0.0	18.78	"

Melting points in the system $NH_4SO_3NH_2$ + $NaSO_3NH_2$ are given by Laning and van der Meulen, 1948.

WO AMMONIUM Para TUNGSTATE $5(NH_4)_2O \cdot 12WO_3 \cdot 11H_2O$

SOLUBILITY IN AMMONIA SOLUTIONS AT 19°

(Dawihl, 1940)

The solubility of ammonium paratungstate increased with increasing amounts of free ammonia in solution, and also with time. There was no evidence of a constant value having been attained after 14 months contact with the solutions, although the temperature variation ($\pm$ 2°) was large enough to make the accuracy of the results $\pm$ 0.2% (abs.). Some typical results were as follows: (in gms. salt per 100 gms. Saturated Solution).

	% NH_3			
Time	0	0.94	6.25	12.0
4 days	1.5	1.6	1.5	1.4
4 months	1.1	2.5	6.3	5.7
13 months	1.1	3.2	12.1	13.3

O NITROUS OXIDE N_2O

Correction to Volume I: p. 1137 (Manchot, Jahrstorfer, and Zeptner, 1924).

The reference is Z. anorg. Chem. 141 38, 45 (1924)

SOLUBILITY OF NITROUS OXIDE IN WATER

(Markham and Kobe, 1941)

t°	Ml (0°, 760 mm) N_2O Dissolved in 1ml. H_2O
0.2	1.2970
25	0.5392 (0.549 Orcutt and Seevers, 1937)
40	0.3579

SOLUBILITY OF NITROUS OXIDE IN AQUEOUS SALT SOLUTIONS

(Markham and Kobe, 1941)

β = Ml. N_2O (measured at 0°, 760 mm.) dissolved in 1 ml. of solution.

S = Ml. N_2O (measured at 0°, 760 mm.) dissolved in that volume of solution which contains one gram of water.

Moles Added Salt per 1000 gms. H_2O	KCl		NaCl		KNO_3	
	β	S	β	S	β	S
			0.2°			
0.2					1.2183	1.2267
0.5					1.1355	1.1556
1	0.9880	1.0140	0.9178	0.9327	1.0174	1.0545
2	.7784	0.8212	.6675	.6902		
3	.6349	.6893	.5053	.5330		
			25°			
1	.4329	.4466	.4026	.4127	0.4552	0.4749
2	.3580	.3803	.3166	.3299	.3961	.4299
3	.3030	.3315	.2502	.2662	.3524	.3978
			40°			
1	.2885	.2995	.2719	.2797	.3100	.3254
2	.2416	.2613	.2181	.2288	.2761	.3018
3	.2077	.2286	.1743	.1866	.2475	.2814

	$Mg(NO_3)_2$		$MgSO_4$		Na_2SO_4	
	β	S	β	S	β	S
			0.2°			
0.5	1.0139	1.0316	0.8778	0.8777		
1	0.7921	0.8215	.6019	.6039		
2	.5238	.5664	.2771	.2820		
3	.3618	.4079				
			25°			
0.5	.4488	.4593	.3840	.3858	0.3565	0.3612
1	.3850	.4023	.2790	.2816	.2476	.2547
2	.2785	.3042	*.1442	.1478	.1721	.1797
3	.2104	.2403				
			40°			
0.5	.3061	.3150	.2612	.2638	.2425	.2472
1	.2620	.2756	.1945	.1969	.1722	.1791
2	.1989	.2188	*.1018	.1049	.1226	.1297
3	.1556	.1793				

*1.5 Molal salt solutions

The authors also present empirical equations expressing their results.

SOLUBILITY OF NITROUS OXIDE IN WATER AND ETHYL ALCOHOL

(Carius, 1855)

The alcohol had a density of 0.792 at 20°.

Results in Water				Results in Alcohol			
t°	β	t°	β	t°	β	t°	β
0	1.305	15	0.778	0	4.178	15	3.268
5	1.095	20	.670	5	3.844	20	3.025
10	0.920	25	.596	10	3.541	25	2.813

Henrich (1892) recalculated Bunsen's data for the solubility of nitrous oxide in water and in alcohol and obtained the equations:

β in alc. $= 4.1902 - 0.074389\ t + 0.00078226\ t^2$

β in $H_2O = 1.30263 - 0.046254\ t + 0.00072154\ t^2$

The results calculated from these equations are not, however, in good agreement with those of other workers (Vol. I, p. 1135, 1142).

The solubility of nitrous oxide in olive and sesame oils from 17° to 37° was determined by Meyer and Gottlieb-Billroth, 1921.

SOLUBILITY OF NITROUS OXIDE IN HUMAN BLOOD

t°	(ml. N_2O 0°, 760 mm. per ml. Blood)	
38	0.417	Siebeck (1909)
37.5	.416	Orcutt and Seevers (1937)
37.5	.415	Cullen and Cook (1948)

O NITRIC OXIDE NO

SOLUBILITY OF NITRIC OXIDE IN SULFURIC ACID SOLUTIONS OF NITROSYL SULFURIC ACID

(Zeitlin, 1946)

Solvent		Ml. NO (measured at 18°, 760 mm.) Absorbed per ml. of Solvent	
Density at 15°	% N_2O_3	40°	70°
1.695	1.18	1.47	1.61
1.697	4.3	6.40	6.20
1.667	1.11	2.85	2.93
1.669	3.86	10.10	10.20

SOLUBILITY OF NITRIC OXIDE IN METHANOL

(Riccoboni, 1941)

The volume of NO absorbed by one volume of methanol was determined at partial pressures of NO ranging from 400 to 1400 mm. At each temperature the volume dissolved was a linear function of the pressure.

Temperature	0°	10°	20°	30°
Ml. NO per ml. CH_3OH (at 1 atm. pressure of NO)	0.3635	0.3622	0.3506	0.347

SOLUBILITY OF NITRIC OXIDE IN ETHYL ALCOHOL

(Carius, 1855)

The ethyl alcohol had a density of 0.792 at 20°.

t°	β	t°	β
0	0.3161	15	0.2748
5	.2999	20	.2659
10	.2861	25	.2595

Equilibrium constants for the reaction $2NO + O_2 \rightleftharpoons 2NO_2$ and the system $3NO_2 + H_2O \rightleftharpoons 2HNO_3 + NO$ at 0° are given by Epstein (1939).

NITROGEN DIOXIDE NO_2 O

5 cc. of NO_2 dissolve in 1 cc. of H_2SO_4 containing 7.2 - 8.3% HNO_3 at room temperature. (Kirichenko, 1940).

SODIUM Na Na

The eutectic temperature in the system Sodium - Ammonia is about -110°. (Birch and MacDonald, 1947).

Cubicciotti (1949) studied the system Na - NaI - NH_3 at -33°. Two liquid layers are formed, and Na + NaI are miscible in all proportions only when the mole fraction of NH_3 is greater than 0.97.

Sienko, 1949 found that the addition of NaI to mixtures of Na + NH_3 increased the miscibility of the components.

SODIUM ALUMINATES $xNa_2O \cdot yAl_2O_3 \cdot zH_2O$ AlO

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - ALUMINUM OXIDE - WATER AT 25°

(Sprauer and Pearce, 1940)

The results agree with those of Jucatis (Vol. I, p. 1147).

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2O	Al_2O_3	
38.5	0.65	$Na_2O \cdot Al_2O_3 \cdot 2.5H_2O + 3Na_2O \cdot Al_2O_3 \cdot 6H_2O$
36.0	0.97	$Na_2O \cdot Al_2O_3 \cdot 2.5H_2O$
28.8	2.16	"
26.0	6.05	"
21.1	15.5	"
20.9	23.6	$Na_2O \cdot Al_2O_3 \cdot 2.5H_2O + Al_2O_3 \cdot 3H_2O$
20.1	23.4	"
18.6	9.7	$Al_2O_3 \cdot 3H_2O$

At 25°, 3.57 gms. sodium aluminate dissolve in 100 gms. ethylene glycol.
" " 0.36 " " " " " " " " propylene glycol.

(Palit, 1947)

Melting points in the system $NaAlO_2 - NaFeO_2$ are given by Toropov and Shisacov, 1939.

EQUILIBRIUM IN THE SYSTEM ARSENIC TRIOXIDE - SODIUM OXIDE - WATER AT 35°

(Nelson, 1941)

These results differ from those of Schreinemakers and deBaat at 25° (Vol. I, p. 1147), who found the phases $Na_4As_2O_5 \cdot 9H_2O$ and $Na_{10}As_4O_{11} \cdot 26H_2O$ and did not find $2Na_2O \cdot As_2O_3 \cdot 7H_2O$ nor $Na_2O \cdot 3As_2O_3$. Nelson points out that Schreinemakers and deBaat's data did not justify assigning the formula $Na_4As_2O_5 \cdot 9H_2O$ and that the $Na_{10}As_4O_{11} \cdot 26H_2O$ is improbable for theoretical reasons.

Gms. As_2O_3 per 100 gms. Sat. Sol.	Gms. Na_2O per 100 gms. Sat. Sol.	Solid Phase
6.3	42.0	$NaOH \cdot H_2O$
6.3	41.5	$2Na_2O \cdot As_2O_3$
5.7	41.0	"
9.2	38.4	"
9.8	38.4	"
11.6	36.4	"
12.8	35.8	"
15.4	34.9	"
16.3	34.4	"
20.0	33.4	"
19.5	32.6	$2Na_2O \cdot As_2O_3 \cdot 7H_2O$
17.9	31.0	"
18.0	28.9	"
18.8	28.2	"
20.2	26.1	"
22.8	24.9	"
25.5	24.0	"
26.3	24.1	"
29.4	23.2	"
34.5	23.1	$Na_2O \cdot As_2O_3$
34.4	22.5	"
36.2	20.2	"
37.3	18.5	"
39.6	16.9	$Na_2O \cdot As_2O_3$
45.8	15.2	"
48.9	14.7	"
54.2	13.9	"
58.0	13.7	"
58.7	13.5	$Na_2O \cdot 3As_2O_3$
55.2	12.8	"
53.1	12.2	"
52.1	11.2	"
50.3	11.0	"
48.2	10.2	"
47.1	9.1	"
45.3	7.6	$Na_2O \cdot 3As_2O_3 + As_2O_3$
45.5	7.7	
44.6	7.5	As_2O_3
40.1	6.8	"
36.9	6.2	"
32.5	5.4	"
31.8	5.4	"
23.3	3.9	"
19.8	3.3	"
18.2	3.0	"
14.9	2.5	"

At 25°, 28.06 gms. sodium metaarsenite dissolve in 100 gms. ethylene glycol.

At 25°, 20.84 gms. sodium metaarsenite dissolve in 100 gms. propylene glycol.

(Palit, 1947)

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - ARSENIC PENTOXIDE - WATER AT 30°

(Serebrennikova, 1939)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
As_2O_5	Na_2O			As_2O_5	Na_2O		
72.53	0.0	2.208	A	21.65	12.69	-	D
68.30	1.97	-	A	22.50	13.74	1.422	D + E
67.42	2.39	-	A	21.22	13.53	1.415	E
68.6	3.4	-	A + B	19.81	12.76	1.361	E
65.85	4.00	2.015	B	18.01	12.01	-	E
65.61	4.22	2.110	B	15.86	11.12	-	E
63.34	5.03	2.049	B	10.82	8.85	-	F
63.42	5.13	2.053	B	8.85	7.44	-	F
60.66	6.43	2.010	B	7.60	6.87	1.143	F
59.36	7.45	1.995	B	6.94	6.61	1.138	F
59.16	7.82	1.988	B	6.66	6.51	1.140	F
61.20	8.90	2.071	B + C	6.58	6.53	1.142	F
61.34	8.97	2.066	C	6.40	6.53	-	F
59.92	9.02	2.048	C	4.96	6.36	-	F
57.97	9.01	2.030	C	4.59	6.40	1.130	F
56.08	8.87	1.949	C	4.49	6.11	1.127	F
53.47	9.22	1.850	C	3.89	6.53	1.120	F
52.27	9.07	1.858	C	3.22	6.40	-	G
50.55	9.63	1.840	C	2.79	6.66	1.114	G
45.26	10.34	1.727	C	2.46	6.68	1.115	G
43.15	10.72	1.710	C	1.95	8.69	1.118	G
41.38	11.07	1.674	C	1.61	8.57	1.131	G
41.40	11.17	1.675	C	1.22	8.69	-	G
41.10	12.00	1.667	C	1.20	9.35	1.126	G
41.49	12.36	-	C	0.34	13.33	1.174	G
41.27	13.29	1.715	C	.44	15.71	-	G
41.21	13.66	1.738	C	.23	17.47	-	G
42.77	15.15	1.779	C	.22	20.06	-	G
43.52	16.36	1.855	C	.41	26.16	-	G
44.23	17.02	-	C + D	.43	26.70	-	G + H
33.58	13.96	1.579	D	.49	26.79	-	H
28.47	12.74	1.505	D	.59	30.97	-	H
26.03	12.22	1.453	D	.24	37.77	-	H
20.70	11.04	-	D				

A = $3As_2O_5 \cdot 5H_2O$

B = $NaH_2AsO_4 \cdot H_3AsO_4 \cdot H_2O$

C = $NaH_2AsO_4 \cdot H_2O$

D = $Na_2HAsO_4 \cdot 7H_2O$

E = $Na_3AsO_4 \cdot 12H_2O$

F = Solid Solution

G = $3(Na_3AsO_4) \cdot NaOH \cdot H_2O$ (?)

H = $Na_3AsO_4 \cdot NaOH \cdot 10H_2O$ (?)

AsO

BO SODIUM Meta BORATE $NaBO_2$

SOLUBILITY OF SODIUM METABORATE IN WATER
(Blasdale and Slansky, 1939)

t°	Gms. $NaBO_2$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $NaBO_2$ per 100 Gms. Sat. Sol.	Solid Phase
0	14.10	$NaBO_2 \cdot 4H_2O$	54	37.85	$NaBO_2 \cdot 4H_2O$ + $NaBO_2 \cdot 2H_2O$
5	15.70	"			
10	17.23	"	55	38.12	$NaBO_2 \cdot 2H_2O$
15	18.50	"	60	39.00	"
20	20.22	"	65	40.35	"
25	22.00	"	70	41.90	"
30	23.90	"	75	43.80	"
35	26.22	"	80	45.80	"
40	28.75	"	85	48.10	"
45	31.81	"	90	50.35	"
50	35.02	"	95	52.80	"
			100	55.60	"

FREEZING POINTS OF SOLUTIONS OF SODIUM METABORATE
(Menzel and Schulz, 1943)

t°	Gms. $NaBO_2$ per 100 gms. H_2O	Moles $NaBO_2$ per 1000 gms. H_2O	t°	Gms. $NaBO_2$ per 100 gms. H_2O	Moles $NaBO_2$ per 1000 gms. H_2O
-0.511	1.011	0.1551	-4.822	11.15	1.906
-1.286	2.695	.4208	-5.524	12.61	2.192
-2.532	5.732	.9238	-5.768	13.10	2.289*
-4.084	9.511	1.597			

*Eutectic (Ice + $NaBO_2 \cdot 4H_2O$)

At 25°, 6.98 gms. sodium metaborate dissolve in 100 gms. ethylene glycol
" " 3.36 " " " " " " " propylene glycol
(Palit, 1947)

Specific volumes in the system $NaBO_2$ + $NaPO_2$ were determined by Leontjewa, 1937.

BO SODIUM Tetra BORATE $Na_2B_4O_7$

SOLUBILITY OF SODIUM TETRABORATE IN WATER
(Blasdale and Slansky, 1939)

It was found that the stable phase above 58.5° was $Na_2B_4O_7 \cdot 4H_2O$ (Kernite) rather than $Na_2B_4O_7 \cdot 5H_2O$ as had been previously supposed. The penta hydrate was remarkably stable even at the boiling point, but solutions containing the salt which were kept at 95° for five days gradually became less concentrated as the tetra hydrate was formed.

t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.	Solid Phase
0	1.18	$Na_2B_4O_7 \cdot 10H_2O$	75	18.41	$Na_2B_4O_7 \cdot 4H_2O$
5	1.44	"	80	19.88	"
10	1.76	"	85	21.48	"
15	2.12	"	90	23.31	"
20	2.58	"	95	25.55	"
25	3.13	"	100	28.22	"
30	3.85	"	^{m}60.8	16.65	$Na_2B_4O_7 \cdot 10H_2O$ + $Na_2B_4O_7 \cdot 5H_2O$
35	4.76	"	^{m}65	17.88	$Na_2B_4O_7 \cdot 5H_2O$
40	6.00	"	^{m}70	19.49	"
45	7.58	"	^{m}75	21.30	"
50	9.55	"	^{m}80	23.38	"
55	12.25	"	^{m}85	25.73	"
58.5	14.52	$Na_2B_4O_7 \cdot 10H_2O$ + $Na_2B_4O_7 \cdot 4H_2O$	^{m}90	28.37	"
60	14.82	$Na_2B_4O_7 \cdot 4H_2O$	^{m}95	31.28	"
65	15.88	"	^{m}100 -	34.63	"
70	17.12	"	*102.8	36.73	"

*Boiling point ^{m} = Metastable

SOLUBILITY OF SODIUM TETRABORATE IN WATER

(Menzel and Schulz, 1940)

The pentahydrate is metastable over the entire temperature range.

Solid Phase $Na_2B_4O_7 \cdot 4H_2O$

t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.	t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.
54.5	13.86*	70.5	17.25
58.65	14.60	80.0	19.99
60.0	14.80	90.2	23.48
62.5	15.42	98.7	27.55
65.0	15.90		

Solid Phase $Na_2B_4O_7 \cdot 5H_2O$

t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.
34.9	10.97*
45.1	12.90*
54.8	15.01*
55.05	15.34*
61.2	16.71*
62.2	16.98*
62.55	17.02*
64.1	17.55*
70.0	19.37*
79.55	23.20*
90.2	27.83*
98.35	33.44*

Solid Phase $Na_2B_4O_7 \cdot 10H_2O$

t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.
-0.435	1.005^e
18.0	2.271
20.1	2.48
25.0	3.06
32.4	4.24
39.65	5.91
44.8	7.29
50.1	9.33
54.1	11.41
55.0	12.32
55.3	12.65
57.1	13.81
59.0	15.04
60.15	16.03

*Metastable ^{e}Eutectic

The transition $Na_2B_4O_7 \cdot 10H_2O \rightleftharpoons Na_2B_4O_7 \cdot 4H_2O$ occurs at 58.2°, 14.55% $Na_2B_4O_7$ in solution.

The transition $Na_2B_4O_7 \cdot 10H_2O \rightleftharpoons Na_2B_4O_7 \cdot 5H_2O$ occurs at 60.6°, 16.55% $Na_2B_4O_7$ in solution.

SOLUBILITY OF SODIUM TETRABORATE IN WATER ABOVE 100°

(Benrath, 1942)

t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.	t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.	t°	Gms. $Na_2B_4O_7$ per 100 gms. Sat. Sol.
108	38	125	52.8	132	60
116	43	126	53.9	135	63.1
121	48	130	57	137	66.2
				140	69.1

SOLUBILITY OF SODIUM TETRABORATE IN SODIUM CARBONATE SOLUTIONS AT 35°

(Hill, 1945)

The solid phase was $Na_2B_4O_7 \cdot 10H_2O$.

B/O

Gms. per 100 gms. Sat. Sol.		Density	Gms. per 100 gms. Sat. Sol.		Density
Na_2CO_3	$Na_2B_4O_7$		Na_2CO_3	$Na_2B_4O_7$	
0.0	4.84	1.036	14.02	3.19	1.172
3.27	3.33	1.058	17.32	3.30	1.210
6.41	3.41	1.090	20.46	3.28	1.243
10.47	3.40	1.134			

EQUILIBRIUM IN THE SYSTEM SODIUM TETRABORATE - SODIUM CARBONATE - WATER

(Umeda, 1945)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2CO_3	$Na_2B_4O_7$		Na_2CO_3	$Na_2B_4O_7$	
	Results at 30°			Results at 35°	
28.81	1.22	$Na_2CO_3 \cdot 10H_2O$	32.65	0.77	$Na_2CO_3 \cdot 6H_2O$
29.95	2.65	"	32.48	1.65	"
28.75	2.73	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 6H_2O$	32.77	1.79	"
28.89	2.73	"	32.52	1.81	$Na_2CO_3 \cdot 4H_2O$
29.03	2.59	$Na_2CO_3 \cdot 6H_2O$	32.50	2.22	"
29.67	3.28	"	32.16	2.59	"
29.62	3.38	$Na_2CO_3 \cdot 6H_2O + Na_2CO_3 \cdot 4H_2O$	31.27	3.12	$Na_2CO_3 \cdot 2H_2O$
29.33	3.27	$Na_2CO_3 \cdot 4H_2O$	31.02	4.28	"
28.89	4.36	"	30.53	4.57	"
			29.61	5.31	"
	Results at 55°		28.73	5.51	"
3.31	10.01	$Na_2B_4O_7 \cdot 10H_2O$		Results at 60°	
4.64	9.50	"			
8.09	9.15	"	2.22	14.29	$Na_2B_4O_7 \cdot 4H_2O$
17.38	9.36	"	7.57	12.88	"
18.18	9.26	"	11.22	12.19	"
18.34	9.51	$Na_2B_4O_7 \cdot 10H_2O + Na_2B_4O_7 \cdot 4H_2O$	14.25	10.89	"
20.65	9.16	"	24.24	7.80	"
20.40	6.35	"	27.44	10.11	$Na_2CO_3 \cdot H_2O$
24.09	7.69	"			
26.76		$Na_2CO_3 \cdot H_2O$			

SOLUBILITY OF MIXTURES OF SODIUM TETRABORATE + SODIUM CHLORIDE IN MAGNESIUM SULFATE SOLUTIONS

(Schlesinger, Feigelson, and Spiriagina, 1938)

Each solution was saturated with both $Na_2B_4O_7$ and NaCl.

Results at 35°				Results at 50°		
Gms. per 100 gms. Sat. Sol.			Density	Gms. per 100 gms. Sat. Sol.		
$MgSO_4$	NaCl	$Na_2B_4O_7$		$MgSO_4$	NaCl	$Na_2B_4O_7$
0.0	25.93	1.42	1.2034	1.51	24.38	3.75
1.34	25.05	2.14	1.2199	4.15	22.27	4.32
2.64	24.10	3.10	1.2373	7.02	20.65	4.69
3.82	23.17	3.76	1.2512			
5.03	22.14	4.68	1.2670			
6.00	20.92	5.83	1.2834			

Melting points in the systems $Na_2B_4O_7$ + NaCl and $Na_2B_4O_7$ + NaF were determined by Bergman and Nikonova, 1942.

Specific volumes in the system $Na_2B_4O_7$ - $NaPO_2$ are given by Leontjewa, 1937.

SODIUM Penta BORATE $Na_2B_5O_8$ BO

SOLUBILITY OF SODIUM PENTABORATE IN WATER

(Blasdale and Slansky, 1939)

The solid phase was $NaB_5O_8 \cdot 5H_2O$

t°	Gms. NaB_5O_8 per 100 gms. Sat. Sol.	t°	Gms. NaB_5O_8 per 100 gms. Sat. Sol.	t°	Gms. NaB_5O_8 per 100 gms. Sat. Sol.
0	6.28	35	15.60	70	32.25
5	7.10	40	17.40	75	34.98
10	8.10	45	19.63	80	37.84
15	9.30	50	21.80	85	40.77
20	10.55	55	24.30	90	43.80
25	12.20	60	26.90	95	47.05
30	13.75	65	29.35	100	50.30

THE QUATERNARY SYSTEM $Na_2O - B_2O_3 - CO_2 - H_2O$ AT 35°

(Hill, 1945)

BO

Gms. per 100 gms. Sat. Sol.			Density	Solid Phase
Na_2O	B_2O_3	CO_2		
19.2	-	13.8	-	7 + S*
11.9	-	9.6	-	S + H*
16.14	2.52	10.46	1.304	S
17.94	3.27	11.15	1.348	S
18.95	2.88	11.90	1.360	S
16.13	2.49	10.55	1.306	S + B
17.78	3.27	11.01	1.343	S + B
19.25	4.35	11.31	1.379	M + B + S
12.41	1.99	9.26	1.232	H + B + S

7 = $Na_2CO_3 \cdot 7H_2O$ S = $Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$ H = $NaHCO_3$

B = $Na_2B_4O_7 \cdot 10H_2O$ M = $Na_2CO_3 \cdot H_2O$

*Freeth; Phil. Trans. 1922, A, 223, 65.

Br **SODIUM BROMIDE** NaBr

SOLUBILITY OF SODIUM BROMIDE IN DEUTERIUM OXIDE

(Eddy and Menzies, 1940)

See note p. 67

Solid Phase $NaBr \cdot 2D_2O$

t°	Gms. NaBr per 100 gms. H_2O
0	78.3
10	83.6
20	89.8
30	97.1
40	105.6
47.4	113.0*

Solid Phase NaBr

t°	Gms. NaBr per 100 gms. H_2O	t°	Gms. NaBr per 100 gms. H_2O
40	11.26(m)	110	12.03
50	11.31	120	12.20
60	11.39	130	12.40
70	11.48	140	12.61
80	11.59	150	12.84
90	11.72	160	13.11
100	11.88	170	13.39

*Solid Phases: $NaBr \cdot 2D_2O$ + NaBr (m) = Metastable

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - SODIUM BROMATE - WATER AT 35°

(Klebanov and Basova, 1939)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NaBr	$NaBrO_3$		NaBr	$NaBrO_3$	
50.57	0.0	$NaBr \cdot 2H_2O$	18.18	15.30	$NaBrO_3$
47.92	3.31	$NaBr \cdot 2H_2O + NaBrO_3$	8.73	22.59	"
39.69	4.94	$NaBrO_3$	0.0	31.95	"
27.94	9.69	"			

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - SODIUM BICARBONATE - WATER

(Klebanov and Bosova, 1939)

Results at 25°			Results at 35°		
Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NaBr	$NaHCO_3$		NaBr	$NaHCO_3$	
48.43	0.0	$NaBr \cdot 2H_2O$	50.57	0.0	$NaBr \cdot 2H_2O$
47.91	0.44	$NaBr \cdot 2H_2O + NaHCO_3$	49.20	0.48	$NaBr \cdot 2H_2O + NaHCO_3$
44.94	.48	$NaHCO_3$	47.55	.48	$NaHCO_3$
33.80	1.03	"	40.60	.73	"
27.05	2.16	"	31.17	1.45	"
13.60	3.38	"	18.32	3.67	"
7.44	6.49	"	11.19	5.04	"
0.0	9.34	"	0.0	10.55	"

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - SODIUM CARBONATE - WATER AT 80° Br

(Klebanov and Basova, 1939)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NaBr	Na_2CO_3		NaBr	Na_2CO_3	
54.35	0.0	NaBr	29.58	8.64	$Na_2CO_3 \cdot H_2O$
52.67	1.05	$NaBr + Na_2CO_3 \cdot H_2O$	16.25	17.26	"
47.74	1.90	$Na_2CO_3 \cdot H_2O$	10.47	21.86	"
42.35	3.28	"	0.0	30.95	"
35.05	5.91	"			

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE, SODIUM BROMATE, SODIUM BICARBONATE - WATER

(Klebanov and Basova, 1939)

Results at 25°				Results at 35°			
Gms. per 100 gms. Sat. Sol.			Solid Phases	Gms. per 100 gms. Sat. Sol.			Solid Phases
NaBr	$NaBrO_3$	$NaHCO_3$		NaBr	$NaBrO_3$	$NaHCO_3$	
47.91	0.0	0.44	A, B	49.20	0.0	0.48	A, B
46.92	1.92	.38	A, B	49.60	0.90	.46	A, B
46.20	3.06	.42	A, B, C	48.82	1.78	.46	A, B
46.82	2.94	0.00	A, C	47.94	2.98	.52	A, B
39.07	4.44	0.62	B, C	47.79	3.20	.50	A, B, C
31.25	6.95	.70	B, C	47.92	3.31	0.00	A, C
27.96	8.09	.98	B, C	41.05	4.66	0.60	B, C
18.97	12.18	1.50	B, C	33.85	6.92	.78	B, C
10.08	17.44	3.04	B, C	28.85	8.76	1.04	B, C
4.34	21.52	3.94	B, C	17.48	15.12	1.60	B, C
0.0	24.34	4.76	B, C	9.68	19.72	2.94	B, C
26.85	7.68	1.17	B	0.0	28.02	4.88	B, C
25.83	7.29	1.33	B				
22.14	6.50	1.50	B				
10.28	2.97	4.52	B				
4.91	1.42	6.52	B				
0.0	0.0	9.34	B				

A = $NaBr \cdot 2H_2O$
B = $NaHCO_3$
C = $NaBrO_3$

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - SODIUM BROMATE - SODIUM CARBONATE - WATER AT 80°

(Klebanov and Basova, 1939)

Gms. per 100 gms. Sat. Sol.			Solid Phase
NaBr	$NaBrO_3$	Na_2CO_3	
52.67	0.0	1.05	$NaBr + Na_2CO_3 \cdot H_2O$
48.20	6.60	1.18	$NaBr + Na_2CO_3 \cdot H_2O + NaBrO_3$
52.20	6.25	0.0	$NaBr + NaBrO_3$
29.82	12.26	4.66	$NaBrO_3 + Na_2CO_3 \cdot H_2O$
17.05	17.09	9.34	"
10.81	19.18	11.80	"
0.0	21.88	18.84	"

Br

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - LEAD BROMIDE - WATER AT 25°

(Roger, 1944)

The index of refraction of many solutions were also determined.

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
$PbBr_2$	NaBr			$PbBr_2$	NaBr		
0.975	0.0	1.0049	A	36.23	30.76	2.107	A
.733	0.221	-	A	38.34	31.09	2.179	A
.502	0.650	-	A	38.70	31.13	2.206	A, C
.310	1.45	-	A	36.43	31.25	-	C
.249	3.12	-	A	35.43	31.90	2.136	C
.332	4.95	-	A	36.76	33.35	2.196	C
.364	6.85	-	A	38.04	34.28	2.299	C, B
.543	9.10	-	A	37.37	34.68	2.275	B
.715	11.23	-	A	35.40	35.98	2.234	B
4.80	22.94	1.264	A	29.82	38.33	-	B
17.18	27.77	1.525	A	19.46	42.13	1.861	B
27.15	29.38	1.778	A	0.0	48.81	1.543	B
30.78	29.34	1.891	A				

A = $PbBr_2$ B = $NaBr \cdot H_2O$ C = $4PbBr_2 \cdot 3NaBr \cdot 12H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - SODIUM CHLORIDE - WATER

(Vlassov and Bergman, 1943)

The salts form continuous dihydrated solid solutions below 0.15° and continuous anhydrous solid solutions above 50.2°. Between these temperatures both series are found.

Data of Vlassov and Bergman, 1943

Gms. per 100 gms. Sat. Sol. NaBr	Gms. per 100 gms. Sat. Sol. NaCl	Solid Phase
	Results at -20°	
32.8	0.0	Ice
32.1	0.8	"
29.2	2.6	"
17.8	10.2	"
8.3	16.8	"
0.0	22.3	"
0.0	23.7	$NaCl \cdot 2H_2O$
8.0	19.1	$S.S. \cdot 2H_2O$
17.0	13.8	"
27.0	9.0	"
30.8	7.0	"
33.7	5.3	"
36.8	3.4	"
40.5	0.9	"
41.7	0.0	$NaBr \cdot 2H_2O$
	Results at 0°	
44.3	0.0	$NaBr \cdot 2H_2O$
43.7	0.9	$S.S. \cdot 2H_2O$
40.8	2.8	"
35.8	5.7	"
32.8	7.5	"
30.0	9.3	"
26.6	11.0	"
21.4	14.0	$S.S. \cdot 2H_2O + S.S.$
0.0	26.2	$NaCl \cdot 2H_2O$
	Results at 20°	
47.6	0.0	$NaBr \cdot 2H_2O$
46.8	0.8	$S.S. \cdot 2H_2O$
46.6	1.0	"
43.8	2.8	"
42.4	4.3	$S.S. \cdot 2H_2O + S.S.$
39.8	5.2	S.S.
35.2	7.3	"
32.55	8.65	"
29.7	10.1	"
26.5	11.5	"
16.5	16.9	"
7.8	21.9	"
0.0	26.37	NaCl
	Results at 30°	
49.4	0.0	$NaBr \cdot 2H_2O$
48.2	1.0	$S.S. \cdot 2H_2O$
45.6	3.2	$S.S. \cdot 2H_2O + S.S.$
43.1	4.1	S.S.
39.8	5.2	"
35.2	7.40	"
32.5	8.65	"
29.7	10.2	"
26.50	11.6	"
16.6	17.0	"
7.7	22.0	"
0.0	26.52	NaCl
	Results at -10°	
21.6	0.0	Ice
19.6	1.6	"
9.2	7.8	"
0.0	13.4	"
0.0	24.8	$NaCl \cdot 2H_2O$
7.9	20.3	$S.S. \cdot 2H_2O$
16.8	15.1	"
26.9	9.8	"
30.4	8.3	"
33.2	6.4	"
36.2	4.6	"
41.4	1.2	"
42.0	0.9	"
43.2	0.0	$NaBr \cdot 2H_2O$
	Results at 10°	
45.9	0.0	$NaBr \cdot 2H_2O$
44.6	1.0	$S.S. \cdot 2H_2O$
39.9	4.8	"
37.2	6.2	$S.S. \cdot 2H_2O + S.S.$
35.3	7.1	S.S.
32.6	8.6	"
29.7	10.0	"
26.5	11.45	"
16.6	16.8	"
7.8	21.6	"
0.0	26.33	NaCl
	Results at 25°	
48.6	0.0	$NaBr \cdot 2H_2O$
47.6	1.0	$S.S. \cdot 2H_2O$
46.3	1.8	"
44.6	3.4	$S.S. \cdot 2H_2O + S.S.$
43.2	4.1	S.S.
39.8	5.2	"
35.2	7.35	"
32.5	8.65	"
29.7	10.10	"
26.5	11.5	"
16.6	17.0	"
7.8	21.9	"
0.0	26.48	NaCl
	Results at 50°	
1.75	51.62	S.S.
2.06	49.77	"
3.2	46.38	"
6.14	38.33	"
6.84	36.80	"
19.15	13.21	"
19.26	13.30	"
26.93	0.0	NaCl

Br

Additional Data

-23.8°	41.2	0.0	$B_5 + B_2$	-21.3°	0.0	23.5	$C_2 + I$
-28.2°	40.3	0.0	$B_5 + I$	+50.2°	53.4	0.0	$B_2 + B$
-23.2°	40.0	1.1	$B_5 + S_2$	+32.5°	45.6	3.2	$S_2 + S$
-23.5°	37.0	2.6	"	+13.4°	39.8	5.0	"
-24.0°	33.9	4.9	"	+ 8.0°	35.2	7.0	"
-27.2°	37.7	0.7	$B_5 + I$	+ 6.0°	32.6	8.5	"
-27.0°	37.2	0.9	"	+ 4.0°	30.0	10.0	"
-28.0°	34.6	2.7	"	+ 2.0°	26.4	11.4	"
-29.0°	31.1	6.2	$S_2 + I$	- 2.0°	16.5	16.7	"
-28.8°	27.4	8.2	"	- 3.0°	7.9	21.3	"
-27.6°	17.2	13.2	"	+ 0.15°	0.0	26.3	$C_2 + C$
-22.5°	8.0	18.8	"	+22.0°	43.2	4.1	$S_2 + S$
-29.2°	31.6	6.0	$S_2 + S_5 + I$				

B = NaBr
B_2 = $NaBr \cdot 2H_2O$
B_5 = $NaBr \cdot 5H_2O$
C = NaCl
C_2 = $NaCl \cdot 2H_2O$
I = Ice
S_2 = Dehydrated Solid Solution
S = Anhydrous Solid Solution
S_5 = Pentahydrated Solid Solution

Br EQUILIBRIUM IN THE SYSTEM SODIUM BROMIDE - SODIUM CHLORATE - WATER AT 25°

(Ricci, 1944)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaClO_3$	NaBr		$NaClO_3$	NaBr	
50.10	0.0	$NaClO_3$	13.89	40.28	$NaClO_3 + NaBr \cdot 2H_2O$
37.93	11.86	"	12.38	41.16	$NaBr \cdot 2H_2O$
29.54	20.72	"	8.07	43.74	"
20.87	30.75	"	7.22	44.28	"
16.29	36.77	"	0.0	48.49	"
15.37	38.10	"			

At 50° a solution containing 43.0% $NaClO_3$ and 16.2% NaBr is saturated with $NaClO_3$ and anhydrous NaBr. (Ricci, 1944).

100 gms. of a saturated solution in liquid sulfur dioxide at 25° contain 0.0038 gms. NaBr. (Shatenstein and Viktorov, 1937).

SOLUBILITY OF SODIUM BROMIDE IN AQUEOUS METHANOL SOLUTIONS

(Baron and Mishenko, 1948)

Solvent Wt. % CH_3OH	Gms. NaBr per 100 gms. Sat. Sol.		Gms. NaBr per 100 gms. Solvent	
	25°	40°	25°	40°
25.11	41.4	45.0	70.7	81.9
42.105	37.5	39.3	60.0	64.6
80.48	22.4	23.0	28.9	29.8
100	14.8	13.95	17.36	16.2

SOLUBILITY OF SODIUM BROMIDE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent:	Ethylenediamine	Monoethanolamine	Ethylene Glycol
Gms. NaBr per 100 gms. Solvent	54.4	33.6	35.4

The effect of the addition of 0.04 - 0.10 molar sodium bromide on the mutual solubility of n-butyl alcohol and water is reported by Reber, McNabb, and Lucasse, 1942.

Reactions of the salts below the melting points were studied with X-rays by Link and Wood (1940) for the following pairs:

NaBr + KF NaBr + CsF NaBr + RbF

SODIUM BROMATE $NaBrO_3$ BrO

SOLUBILITY OF SODIUM BROMATE IN DEUTERIUM OXIDE AT 5°
(Noonan, 1948)

$\%D_2O$	Moles $NaBrO_3$ per 100 moles Solvent
91.6	2.899
100	2.867

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE - SODIUM BICARBONATE - WATER
(Klebanov and Basova, 1939)

Results at 25°			Results at 35°		
Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaBrO_3$	$NaHCO_3$		$NaBrO_3$	$NaHCO_3$	
28.14	0.0	$NaBrO_3$	31.95	0.0	$NaBrO_3$
25.94	1.80	"	29.00	2.13	"
24.34	4.76	$NaBrO_3 + NaHCO_3$	28.02	4.88	$NaBrO_3 + NaHCO_3$
18.47	4.90	$NaHCO_3$	23.25	5.02	$NaHCO_3$
12.24	6.18	"	17.88	5.98	"
6.98	7.55	"	11.90	7.40	"
0.0	9.34	"	7.86	8.20	"
			6.26	8.96	"
			0.0	10.55	"

EQUILIBRIUM IN THE SYSTEM SODIUM BROMATE - SODIUM CARBONATE - WATER AT 80°
(Klebanov and Basova, 1939)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaBrO_3$	Na_2CO_3		$NaBrO_3$	Na_2CO_3	
42.51	0.0	$NaBrO_3$	15.51	22.60	$Na_2CO_3 \cdot H_2O$
36.58	5.36	"	8.65	25.75	"
28.10	12.50	"	0.0	30.95	"
21.88	18.84	$NaBrO_3 + Na_2CO_3 \cdot H_2O$			

C SODIUM TETRACHLOROPHTHALATE $C_6Cl_4(COONa)_2$

SOLUBILITY OF SODIUM TETRACHLOROPHTHALATE IN WATER
(Lawlor, 1947)

t°	Gms. $C_6Cl_4(COONa)_2$ per 100 gms. Sat. Sol.	Density	Solid Phase
5	13.9	-	$C_6Cl_4(COONa)_2 \cdot 5H_2O$
7	-	1.095	"
15	15.8	-	"
24.5	17.9	-	"
26	-	1.125	"
26.5	18.5	-	"
31	-	1.135	"
34	20.8	-	"
37.5	22.4	-	"
40	23.0	-	"
45.5	25.1	-	"
58.8	32.2	-	"
61.5	33.0	-	"
63.5	34.0	-	$C_6Cl_4(COONa)_2 \cdot 5H_2O + C_6Cl_4(COONa)_2$
75	34.6	-	$C_6Cl_4(COONa)_2$
77	-	1.188	"
97	35.2	-	"

CH SODIUM FORMATE $NaCHO_2$

EQUILIBRIUM IN THE SYSTEM SODIUM FORMATE - ACETIC ACID
(Davidson and Ramskill, 1941)

t°	Mole % $NaCHO_2$	Solid Phase	t°	Mole % $NaCHO_2$	Solid Phase
16.60	0.0	H	63.1	22.36	$N \cdot 2H$
16.15	0.54	H	66.5	26.34	"
15.60	1.33	H	68.2	28.32	"
14.25	2.96	H	69.0	30.42	"
13.50	3.74	H	69.2	32.17	"
12.75	4.78	H	69.2	32.80	"
11.80	5.79	H	80.0	33.00	$N \cdot H$
10.60	7.27	H	83.0	33.51	"
9.70	8.14	H	87.0	33.98	"
14.55	8.75	$N \cdot 2H$	109	35.24	"
17.70	9.24	"	114	35.73	"
27.10	11.08	"	171	46.46	"
32.25	12.22	"	173	49.81	"
40.10	14.61	"	179	50.17	N
44.35	15.73	"	215	60.48	N
53.0	18.18	"	227	68.93	N
56.2	19.76	"	253	100.0	N

H = $HC_2H_3O_2$ N = $NaCHO_2$

SODIUM ACETATE $NaC_2H_3O_2$

EQUILIBRIUM IN THE SYSTEM SODIUM ACETATE - SODIUM HYDROXIDE - WATER

(Morgan and Walker, 1945)

Results at 0.5°			Results at 10°			Results at 20°		
Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NaOH	$NaC_2H_3O_2$		NaOH	$NaC_2H_3O_2$		NaOH	$NaC_2H_3O_2$	
0.0	26.6	A·3	0.0	28.9	A·3	0.0	31.6	A·3
0.22	26.4	"	2.4	26.6	"	7.8	24.6	"
1.4	24.7	"	6.5	21.7	"	14.0	16.6	"
3.0	22.8	"	11.1	17.5	"	21.6	11.3	"
5.8	20.2	"	15.3	12.8	"	26.2	9.9	"
12.3	13.9	"	21.6	8.2	"	28.8	9.8	"
17.3	9.1	"	23.6	7.1	"	31.4	9.3	A·3 + A
20.6	6.9	"	32.1	6.5	"	32.1	8.5	A
21.9	6.2	"	33.4	6.1	A·3 + A	36.0	5.6	A
23.8	5.3	"	35.6	5.1	A	38.4	4.2	A
29.5	3.6	"	38.9	3.2	A	43.7	2.3	A
37.0	2.9	A·3 + O·3	42.5	2.0	A	46.5	1.8	A
37.4	1.7	O·3	48.0	1.2	A + O·1	49.5	1.4	A + O·1
37.0	3.1	"	47.9	1.2	O·1	50.0	1.0	O·1
38.2	0.0	"	50.0	0.0	"	51.8	0.0	"

A = $NaC_2H_3O_2$ A·3 = $NaC_2H_3O_2 \cdot 3H_2O$ O·1 = $NaOH \cdot H_2O$ O·3 = $NaOH \cdot 3.1H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM ACETATE - FORMIC ACID

(Davidson and Ramskill, 1941)

t°	Mole % $NaC_2H_3O_2$	Solid Phase	t°	Mole % $NaC_2H_3O_2$	Solid Phase
8.4	0.0	$HCHO_2$	-6.0	7.01	$HCHO_2$
7.3	0.76	"	-8.3	8.56	"
6.0	1.43	"	-12.0	9.73	"
4.5	2.39	"	-14.5	10.71	"
3.1	3.20	"	-18.2	11.85	"
0.9	4.17	"	-20.3	12.42	"
-1.5	5.19	"	-22.5	13.11	"
-3.7	6.06	"	-24.0	13.61	" *

SOLUBILITY OF SODIUM ACETATE IN MIXED SOLVENTS AT 25°

(Palit, 1947)

Wt. Ratio Ethylene Glycol: n-Amyl Alcohol:	100:0	80:20	0:100
Gms. CH_3COONa per 100 gms. Solvent	29.5	22.57	0.31

29.03 gms. of sodium acetate dissolve in 100 gms. of ethylene glycol at 25°. (Palit, 1947).

100 gms. of a saturated solution of sodium acetate in furfural at 25° contain 0.04 gms. $NaC_2H_3O_2 \cdot 3H_2O$. (Trimble, 1941).

Melting points in the system Sodium Acetate - Zinc Acetate have been determined by Lehrman and Skell, 1939.

C_3H SODIUM PROPIONATE C_2H_5COONa

SOLUBILITY OF SODIUM PROPIONATE IN GLYCOLS AT 25°
(Palit, 1947)

Solvent	Moles C_2H_5COONa per 1000 gms. Glycol
Ethylene Glycol	3.221
Propylene Glycol	2.072

C_3H SODIUM PROPYLNITRONATE $C_3H_6NO_2Na$
SODIUM ISOPROPYLNITRONATE i-($C_3H_6NO_2Na$)

SOLUBILITY IN GLYCOLS AT 25°
(Palit, 1947)

Sodium Propylnitronate		Sodium Isopropylnitronate	
Solvent	Gms. per 100 gms. Solvent	Solvent	Gms. per 100 gms. Solvent
Ethylene Glycol	39.51	Propylene Glycol	21.84
80 Wt. % Ethylene Glycol + 20 Wt. % n-Amyl Alcohol	34.89	80 Wt. % Propylene Glycol + 20 Wt. % n-Amyl Alcohol	18.82
		n-Amyl Alcohol	0.24

C_3H SODIUM LACTATE $CH_3CHOHCOONa$

FREEZING POINTS OF SODIUM LACTATE SOLUTIONS
(Dietz, Degering, and Schapmeyer, 1941)

t°	Gms. Sodium Lactate per 100 gms. Sat. Sol.	t°	Gms. Sodium Lactate per 100 gms. Sat. Sol.
-2.2	5	-18.2	30
-4.1	10	-32.5	40
-9.7	20		

The density, refractive index, viscosity, boiling points, and surface tension of various sodium lactate solutions are also reported.

C_4H SODIUM TARTARATE $Na_2C_4H_4O_8$

EQUILIBRIUM IN THE SYSTEM SODIUM TARTARATE - SODIUM CARBONATE - WATER AT 17°
(Peyronel, 1949)

Gms. per 100 gms. Sat. Sol.		Solid Phase
$Na_2C_4H_4O_8$	Na_2CO_3	
30.90	0.0	$Na_2C_4H_4O_8 \cdot 2H_2O$
25.83	5.10	"
24.41	6.87	"
20.72	10.46	$Na_2C_4H_4O_8 \cdot 2H_2O + Na_2CO_3 \cdot 10H_2O$
20.30	10.68	$Na_2CO_3 \cdot 10H_2O$
16.25	11.00	"
9.74	13.14	"
0.0	15.85	

EQUILIBRIUM IN THE SYSTEM SODIUM TARTARATE - SODIUM HYDROXIDE - WATER AT 17°

(Peyronel, 1949)

[Selected Data]

Gms. per 100 gms. Sat. Sol.		Solid	Gms. per 100 gms. Sat. Sol.		Solid
$Na_2C_4H_4O_8$	NaOH		$Na_2C_4H_4O_8$	NaOH	
30.90	0.0	T·2	12.47	31.90	T·O·3
24.52	5.82	"	15.65	32.20	T·O·3 + 3T·4O
19.36	11.43	"	12.97	33.68	3T·4O
17.96	17.53	"	10.00	37.00	"
18.37	17.18	"	9.50	40.40	"
20.32	18.16	T·2 + T·O·3	7.63	44.50	"
17.60	19.70	T·O·3	3.40	49.75	"
18.20	21.02	"	3.55	49.40	3T·4O + O·1
10.87	26.43	"	0.0	50.00	O·1
10.13	30.50	"			

$T = Na_2C_4H_4O_8 \cdot 2H_2O$ $T \cdot O \cdot 3 = Na_2C_4H_4O_8 \cdot NaOH \cdot 3H_2O$

$3T \cdot 4O = 3Na_2C_4H_4O_8 \cdot 4NaOH$ $O \cdot 1 = NaOH \cdot H_2O$

SODIUM DILITURATE $C_4H_2N_3O_5Na$ C_4H

SOLUBILITY IN WATER

18° 0.049 moles per liter Sat. Sol. (Fredholm, 1936)

30° { 0.0531 moles per 1000 gms. H_2O (Dermer and Dermer, 1939)
10.34 gms. per 1000 gms. H_2O " " " "

SODIUM VALERATE $CH_3CH_2CH(CH_3)COONa$ C_5H

SOLUBILITY OF SODIUM VALERATE IN GLYCOLS AT 25°

(Palit, 1947)

	Moles C_4H_9COONa per 1000 gms. Glycol
Ethylene Glycol	2.511
Propylene Glycol	1.742

SODIUM CAPROATE $CH_3(CH_2)_4COONa$ C_6H

SOLUBILITY OF SODIUM CAPROATE IN GLYCOLS AT 25°

(Palit, 1947)

	Moles $C_5H_{11}COONa$ per 1000 gms. Glycol
Ethylene Glycol	2.641
Propylene Glycol	1.988

C_6H **SODIUM STYPHNATE** $C_6HO(OH)_2(NO_2)_3Na$

8.43 gms. (0.035 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

CH **SODIUM NITRANILATE** $(C_6H_5N_2O_2)Na$

0.724 gms. (0.00264 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

C_6H **SODIUM PICRATE** $C_6H_2(NO_2)_3ONa$

5.58 gms. (0.0208 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

10% sodium picrate by weight dissolve in acetonitrile at 25°. (Pleskov, 1948).

C_6H **SODIUM CHLOROPICRATE** $C_6H(NO_2)_3(Cl)ONa$

31.2 gms. (0.110 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

C_7H **SODIUM METHYL PICRATE** $C_6H(NO_2)_3(CH_3)ONa$

3.15 gms. (0.0118 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

C_7H **SODIUM BENZOATE** C_6H_5COONa

SOLUBILITY OF SODIUM BENZOATE IN GLYCOL SOLUTIONS AT 25°
(Palit, 1947)

In Ethylene Glycol - n-Amyl Alcohol Mixtures		In Propylene Glycol - Chloroform Mixtures	
Wt. % Glycol	Gms. C_6H_5COONa per 100 gms. Solvent	Wt. % Glycol	Gms. C_6H_5COONa per 100 gms. Solvent
100	24.87	100	15.44
80	21.95	80	13.13
60	17.09	60	10.24
40	12.08	40	7.25
0	1.25	20	3.58
		0	0.07

SODIUM IODOSALICYLATE $C_6H_5I(OH)COONa$ — C_7H

SOLUBILITY OF THE 3-IODO AND 5 - IODO SALTS IN WATER
(Covello, 1941)

t°	Gms. per 100 gms. Sat. Sol.	
	Na 3 - Iodo Salicylate	Na 5 - Iodo Salicylate
18	6.38	4.37
40*	9.0	6.0
60*	14.0	10.0
80*	22.0	16.5
100*	33.0	25.0

*Estimated from curves drawn by the author.

SODIUM CAPRYLATE $CH_3(CH_2)_6COONa$ — C_8H

SOLUBILITY OF SODIUM CAPRYLATE IN GLYCOLS AT 25°
(Palit, 1947)

	Moles $C_7H_{15}COONa$ per 1000 gms. Glycol
Ethylene Glycol	1.746
Propylene Glycol	1.343

SODIUM PHTHALATE $2Na_2C_8H_4O_4 \cdot 7H_2O$ — C_8H

EQUILIBRIUM IN THE SYSTEM SODIUM PHTHALATE - SODIUM CARBONATE - WATER
(Smith and Hoegberg, 1941)

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2CO_3	$Na_2C_8H_4O_4$	
	Results at 25°	
22.50	0.0	$Na_2CO_3 \cdot 10H_2O$
18.13	7.95	"
16.54	10.35	"
13.96	15.66	"
11.25	21.84	"
9.72	25.96	"
9.27	27.54	"
8.13	31.47	"
7.31	35.20	$Na_2CO_3 \cdot 10H_2O + 2Na_2C_8H_4O_4 \cdot 7H_2O$
4.67	38.40	$2Na_2C_8H_4O_4 \cdot 7H_2O$
3.25	39.90	"
0.0	43.88	"

Data of Smith and Hoegberg, 1941 (Con.)

Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. $Na_2C_8H_4O_4$	Solid Phase
	Results at 30°	
28.31	0.0	$Na_2CO_3 \cdot 10H_2O$
27.76	0.84	"
25.81	3.88	"
24.83	5.39	"
22.11	9.98	"
19.72	14.19	"
18.64	16.41	"
17.32	18.97	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
16.93	19.65	$Na_2CO_3 \cdot 7H_2O$
15.25	22.61	"
12.99	26.92	"
11.73	29.58	"
10.71	32.26	$Na_2CO_3 \cdot 7H_2O + 2Na_2C_8H_4O_4 \cdot 7H_2O$
8.04	35.69	$2Na_2C_8H_4O_4 \cdot 7H_2O$
5.11	39.08	"
0.0	45.27	"
	Results at 33°	
31.96	0.0	$Na_2CO_3 \cdot 7H_2O$
29.85	2.55	"
27.81	5.90	"
25.18	9.10	"
21.90	14.17	"
19.72	17.67	"
17.28	21.69	"
16.4	24.12	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot H_2O$
15.80	24.76	$Na_2CO_3 \cdot H_2O$
13.69	27.99	"
12.75	29.52	"
11.68	31.56	$Na_2CO_3 \cdot H_2O + 2Na_2C_8H_4O_4 \cdot 7H_2O$
8.32	35.34	$2Na_2C_8H_4O_4 \cdot 7H_2O$
5.96	38.21	"
3.66	41.01	"
2.33	42.56	"
0.0	45.43	"
	Results at 40°	
32.84	0.0	$Na_2CO_3 \cdot H_2O$
28.47	5.26	"
20.01	17.34	"
15.77	24.11	"
11.80	30.59	"
8.33	37.17	$Na_2CO_3 \cdot H_2O + 2Na_2C_8H_4O_4 \cdot 7H_2O$
7.17	38.49	$2Na_2C_8H_4O_4 \cdot 7H_2O$
3.27	43.23	"
0.0	47.06	"

C_8H SODIUM PHENYLACETATE $C_6H_5CH_2COONa$

Melting points in the system sodium phenylacetate - phenylacetic acid are given by Crawford, 1941.

SODIUM 2-CHLORO-3-NITRO-p-XYLENE SULFONATE $C_6H(CH_3)_2(Cl)(NO_2)SO_3Na$ C_8H

93.4 gms. (0.325 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

SODIUM CAPRATE $CH_3(CH_2)_8COONa$ $C_{10}H$

SOLUBILITY OF SODIUM CAPRATE IN GLYCOLS AT 25°
(Palit, 1947)

	Moles $C_9H_{19}COONa$ per 1000 gms. Glycol
Ethylene Glycol	0.823
Propylene Glycol	0.642

SODIUM DECYL SULFONATE $CH_3(CH_2)_9SO_3Na$ $C_{10}H$

The freezing points of dilute solutions of sodium decyl sulfonates were determined by Johnston and McBain, 1942.

SODIUM PICROLINATE $[C_{10}H_8N_4O_5]Na$ $C_{10}H$

0.285 gms. (0.001 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

SODIUM FLAVIANATE (Dibasic) $[C_{10}H_4O(NO_2)_2SO_3]Na_2$ $C_{10}H$

9.8 gms. (0.027 moles) dissolve in 100 gms. of water at 30°. (Dermer and Dermer, 1939).

SODIUM LAURATE $CH_3(CH_2)_{10}COONa$ $C_{12}H$

ADDITIONAL DATA IN THE SYSTEM SODIUM LAURATE - WATER
(McBain, Vold, and Frick, 1940)
[See Vol. I, p. 1185]

$t°_1$	$t°_2$	Wt. % $CH_3(CH_2)_{10}COONa$
313	-	95.3
296	-	89.5
294	-	85.4
290	-	81.3

SOLUBILITY OF SODIUM LAURATE IN GLYCOLS AT 25°
(Palit, 1947)

	Moles $C_{11}H_{23}COONa$ per 1000 gms. Glycol
Ethylene Glycol	0.536
Propylene Glycol	0.549

SOLUBILITY OF SODIUM LAURATE IN ETHYLENE GLYCOL - n-BUTYL ALCOHOL MIXTURES AT 25°

(Palit, 1947)

Wt. % Glycol in Solvent	0	20	40	60	80	100
Gms. $CH_3(CH_2)_{10}COONa$ per 100 gms. Solvent	0.52	7.84	15.09	20.14	20.05	11.92

$C_{12}H$ SODIUM DODECYL SULFONATE $C_{12}H_{25}SO_3Na$

SOLUBILITY IN SODIUM CHLORIDE SOLUTIONS

(Tarter and Cadle, 1939)

	t°	Gms. $C_{12}H_{35}SO_3Na$ per 100 gms. H_2O		t°	Gms. $C_{12}H_{35}SO_3Na$ per 100 gms. H_2O
	28	0.166		25	0.110
NaCl =	31	.202	NaCl =	30	.157
0.004	33	.233	0.008	33.5	.205
Molal	35	.305	Molal	35	.246
	36	.623		36	.348

$C_{12}H$ SODIUM DODECYL SULFATE $Na[C_{12}H_{25}SO_4]$

At 18°, the solubility in 0.05 N Na_2CO_3 is 5%. (Adam and Pankhurst, 1946).

The freezing points of dilute sodium dodecyl sulfonate solutions were determined by Johnston and McBain, 1942.

$C_{12}H$ SODIUM DIPICRYLAMINATE $Na[(NO_2)_3C_6H_2NHC_6H_2(NO_2)_3]$

SOLUBILITY IN WATER

t°	Moles per liter	Gms. per liter	
20	0.110	50.7	(Treadwell and Hepenstrick, 1949)
25	.145	66.8	(" " " ")
30	.252	116.1*	(Dermer and Dermer, 1939)

*Gms. per 1000 gms. H_2O

$C_{14}H$ SODIUM MYRISTATE $CH_3(CH_2)_{12}COONa$

EQUILIBRIUM IN THE SYSTEM SODIUM MYRISTATE - WATER

(Vold, Reivere, and McBain, 1941)

T_j is the temperature at which the isotropic soap solution separates an anisotropic liquid crystalline phase upon cooling.

T_c is the temperature at which the last trace of "curd fibre" disappears on slow heating.

Data of Vold, Reivere, and McBain, 1941

Wt. %	T_i	T_c	Wt. %	T_i	T_c	Wt. %	T_i	T_c
100.0	316	-	63.8	275	80	43.0	175	-
92.8	292	-	61.3	273	-	40.4	-	64
90.4	289	-	61.0	267	78	35.0	138	61
90.2	290	-	55.4	239	74	32.5	117	61
88.0	290	-	50.7	174	-	29.5	81	-
87.4	291	-	50.5	171	70	24.8	-	58
81.8	292	102	49.9	165	69	17.0	-	56
73.6	288	-	48.3	173	68	9.5	-	52
73.1	288	84	43.9	176	67	5.0	-	48
70.4	286	83				1.0	-	41

SOLUBILITY OF SODIUM MYRISTATE IN GLYCOLS AT 25°
(Palit, 1947)

	Moles $C_{13}H_{27}COONa$ per 1000 gms. Glycol
Ethylene Glycol	0.160
Propylene Glycol	0.197

SOLUBILITY OF SODIUM MYRISTATE IN ETHYLENE GLYCOL - m-BUTYL ALCOHOL MIXTURES AT 25°
(Palit, 1947)

Wt. % Glycol in Solvent	0	20	40	60	80	100
Gms. per 100 gms. Solvent	0.28	4.58	10.12	12.88	11.23	4.00

SODIUM TETRADECYL SULFONATE $C_{14}H_{29}SO_3Na$ $C_{14}H$

SOLUBILITY IN SODIUM CHLORIDE SOLUTIONS
(Tarter and Cadle, 1939)

In 0.004 Molal NaCl				In 0.008 Molal NaCl	
t°	Gms. Na T.D.S. per 100 gms. H_2O	t°	Gms. Na T.D.S. per 100 gms. H_2O	t°	Gms. Na T.D.S. per 100 gms. H_2O
28	0.0126	41.5	0.0503	35	0.0110
30	.0171	43	.0565	40	.0276
33	.0204	44.6	.175	43.5	.059
35	.026	46	.662	44	.083
40	.047			46	.346

$C_{14}H$ SODIUM ANTHRACENE SULFONATES $C_{14}H_9SO_3Na$ $C_{14}H_8S_2O_6Na_2$

SOLUBILITY IN WATER
(Federov and Lodygin, 1942)

	Salt	Gms. Salt per 100 gms. Sat. Sol.	
		20°	100°
α -	$C_{14}H_9SO_3Na$	0.0407	0.420
β -	$C_{14}H_9SO_3Na$	.0088	.109
1, 5	$C_{14}H_8S_2O_6Na_2 \cdot 2H_2O$	2.508	11.250
1, 8	$C_{14}H_8S_2O_6Na_2 \cdot 3H_2O$	2.259	4.399
2, 6	$C_{14}H_8S_2O_6Na_2 \cdot H_2C$	1.213	4.765
2, 7	$C_{14}H_8S_2O_6Na_2 \cdot 2H_2O$	1.090	13.170

$C_{15}H$ SODIUM TRIISOPROPYLBENZENE SULFONATE $C_6H_2(i\text{-}C_3H_7)_3SO_3Na$

SOLUBILITY IN WATER
(Shuck and Lingafelter, 1949)

The data were calculated from a curve drawn by the authors.

t°	Moles Na T.P.B.S. per 1000 gms. H_2O	t°	Moles Na T.P.B.S. per 1000 gms. H_2O
10	0.063	40	0.16
20	.065	50	.39
30	.071		

$C_{16}H$ SODIUM PALMITATE $CH_3(CH_2)_{14}COONa$

SOLUBILITY OF SODIUM PALMITATE IN WATER
(Stauff, 1939)

[Data read from curves drawn by the author]

t°	Moles per liter Sat. Sol.	t°	Moles per liter Sat. Sol.
30	0.0020	45	0.0038
35	.0024	50	.0060
40	.0027	55	.0250

SOLUBILITY OF SODIUM PALMITATE IN VARIOUS SOLVENTS

(Leggett, Vold, and McBain, 1940)

Maximum concentrations of sodium palmitate yielding an isotropic liquid phase.

Solvent	Gms. $NaCH_3(CH_2)_{14}COO$ per 100 gms. Sat. Sol.						
	30°	50°	90°	150°	200°	250°	280°
Water	0.5	1.0	27.5	34.2	50.6	58.5	-
Palmitic Acid	-	-	41.9	64.4	63.3	-	97.2
Glycerol	0.3	1.0	15.8	50.8	53.6	-	91.0
o-Cresol	-	0.2	1.2	9.2	65.4	91.0	95.0
m-Cresol	1.0	2.7	10.0	52.0	73.0	93.0	97.0
p-Cresol	-	1.8	9.0	60.2	76.4	94.0	97.6
Ethyl Alcohol	1.3	2.3	9.7	69.6	87.5	94.8	97.0
Isopropyl Alcohol	0.4	0.6	1.0	24.0	75.0	94.0	97.6
n-Heptyl Alcohol	-	0.3	3.1	31.6	69.5	93.4	97.5
n-Cetyl Alcohol	-	-	1.0	5.8	44.9	85.4	95.0
n-Heptane	0.3	0.4	0.5	0.8	1.0	20.0	86.4
n-Cetane	0.1	0.1	0.3	0.5	1.4	86.4	94.5
Nujol	0.1	0.1	0.1	0.3	0.5	53.3	90.5
Diethylene Glycol	0.4	1.5	9.2	39.9	87.2	90.0	97.3
n-Butylamine	0.2	0.4	1.0	58.0	85.5	91	95
Acetic Acid	-	-	75.5	81.2	85.1	95.3	98.5
Ethyl Acetate	-	-	-	-	-	95.5	97.5
Acetamide	-	-	-	-	78.5	96.2	98.0

$C_{16}H$

These and other data were correlated by means of Hildebrand's ideal solubility relationship by Bondi, 1948.

Solubility determinations and phase studies in the systems Sodium Palmitate - Trisodium Phosphate - Water, Sodium Palmitate - Tetrasodium Pyrophosphate - Water, Sodium Palmitate - Sodium Metasilicate - Water (and other Sodium Silicate NaO/SiO_2 ratios) were made by Merrill and Getty, 1947.

SOLUBILITY OF SODIUM PALMITATE IN GLYCOLS AT 25°

(Palit, 1947)

	Moles $C_{15}H_{31}COONa$ per 1000 gms. Glycol
Ethylene Glycol	0.0426
Propylene Glycol	0.0679

SOLUBILITY OF SODIUM PALMITATE IN ETHYLENE GLYCOL - n-BUTYL ALCOHOL MIXTURES AT 25°

(Palit, 1947)

Wt. % Glycol in Solvent	0	20	40	60	80	100
Gms. $CH_3(CH_2)_{14}COONa$ per 100 gms. Solvent	0.08	2.49	5.85	7.14	5.16	1.19

A dilatometric investigation of the phases in the system Sodium Palmitate - Water was made by Vold and Vold, 1939.

$C_{16}H$ SODIUM CETYL SULFATE $Na[C_{16}H_{33}SO_4]$

At 42°, the solubility in 0.01 N NH_3 is 5% (Adam and Pankhurst, 1946).

$C_{18}H$ SODIUM STEARATE $CH_3(CH_2)_{16}COONa$

See also p. 787

EQUILIBRIUM IN THE SYSTEM SODIUM STEARATE - WATER
(McBain, Vold, and Frick, 1940)

T_i is the temperature at which the isotropic soap solution separates an anisotropic liquid crystalline phase upon cooling.

T_c is the temperature at which the last trace of "curd fibre" disappears on slow heating.

Wt. %	T_i°	T_c°	Wt. %	T_i°	T_c°	Wt. %	T_i°	T_c°
0.37	-	62.7	38.0	169	81.3	79.8	286	104
0.81	-	66.8	39.8	171	81.9	84.7	281	112
1.49	-	68.8	41.9	164	82.4	88.6	274	119
2.51	-	69.8	43.8	147	82.4	89.8	273	-
5.10	-	71.8	45.0	170	82.4	91.2	272	-
7.51	-	72.8	47.8	212	83	92.6	276	-
16.8	-	75.3	49.5	226	83	92.8	276	-
15.3	-	75.6	55.0	256	86	93.2	267	-
19.9	87	76.8	60.3	277	86	94.6	274	-
24.8	124	78.1	64.9	280	87	97.1	277	-
29.6	152	78.8	71.9	284	90	99.6	284	-
34.9	166	80.3	74.5	293	93	100.0	288	-

SOLUBILITY OF SODIUM STEARATE IN GLYCOLS AT 25°
(Palit, 1947)

	Moles $C_{17}H_{35}COONa$ per 1000 gms. Glycol
Ethylene Glycol	0.0156
Propylene Glycol	0.0299

Data for the solubility of sodium stearate in cetane and in cetane-water mixtures is given by Vold and Philipson, 1946.

SOLUBILITY OF SODIUM STEARATE IN ETHYLENE GLYCOL - n-BUTYL ALCOHOL MIXTURES AT 25°
(Palit, 1947)

Wt. % Glycol in Solvent	0	20	40	60	80	100
Gms. per 100 gms. Solvent	0.05	1.47	3.37	3.79	2.16	0.48

The phase relationships of sodium stearate with anhydrous n-heptane, isooctane, cyclohexane, benzene, toluene, ethyl benzene, o-xylene, m-xylene, p-xylene, cumene, n-butylbenzene, and p-cymene were studied by Smith and McBain, 1947.

SODIUM OLEATE $C_8H_{17}CH{=}CH(CH_2)_7COONa$ $C_{18}H$

SOLUBILITY OF SODIUM OLEATE IN MIXED SOLVENTS AT 25°

(Palit, 1947)

Each mixture of solvents contained either ethylene glycol, diethylene glycol, or propylene glycol. Solubilities are given as gms. of sodium oleate per 100 gms. solvent.

Added Solvent	Wt. % Ethylene Glycol in Solvent					
	0	20	40	60	80	100
Ethyl Alcohol	1.61	8.49	15.65	21.61	23.68	16.43
n-Propyl Alcohol	1.13	10.46	21.24	28.50	28.85	16.43
n-Butyl Alcohol	0.98	12.88	25.35	32.28	32.90	16.43
n-Amyl Alcohol	.85	14.74	27.48	34.48	33.64	16.43
With Diethylene Glycol						
Ethyl Alcohol	1.61	8.13	12.41	15.46	14.91	8.05
n-Propyl Alcohol	1.13	-	16.03	19.92	18.74	8.05
n-Butyl Alcohol	0.98	10.46	19.26	23.23	21.26	8.05
n-Amyl Alcohol	.85	-	20.28	24.77	22.27	8.05
Methylene Chloride	.02	14.67	22.33	23.66	19.39	8.05
Chloroform	.02	18.04	25.05	26.51	20.14	8.05
Carbon Tetrachloride	.02	16.63	24.73	25.75	21.47	8.05
Ethylene Chloride	.02	10.38	17.22	19.68	15.00	8.05
With Propylene Glycol						
2-Ethylhexanol	.45	11.04	18.01	22.50	21.90	11.72
Lauryl Alcohol	.4	13.72	21.43	24.96	23.81	11.72
Cetyl Alcohol	Solid		Solid paste		24.29	11.72
Phenol	Solid	21.54	28.21	28.77	24.05	11.72
Cyclohexanol	.36	5.28	12.37	16.78	17.25	11.72
Benzyl Alcohol	.59	5.61	11.55	15.69	16.53	11.72
Ethylene Chloride	.02	10.61	18.73	22.03	21.45	11.72
Methyl Ethyl Ketone	.07	3.99	9.28	14.25	16.20	11.72
Dioxane	.06	1.45	4.56	7.93	10.91	11.72
Trimethylene Chlorohydrin	1.44	5.36	9.79	12.96	13.19	11.72
Trichloro-t-Butyl Alcohol			17.48	18.59	16.71	11.72

	With Propylene Glycol Wt. %					
	0	20.5	40.5	60.4	80.2	100
n-Propyl Alcohol	1.13	6.04	11.39	16.15	16.89	11.72
Isopropyl Alcohol	0.25	3.60	7.45	11.18	13.92	11.72
n-Butyl Alcohol	.98	7.97	14.51	18.35	18.86	11.72
Isobutyl Alcohol	.68	6.41	11.78	17.64	18.25	11.72
s-Butyl Alcohol	.42	3.92	9.42	14.33	15.88	11.72
t-Butyl Alcohol	.24	1.95	5.63	10.71	14.14	11.72
Allyl Alcohol	1.05	5.55	10.07	13.25	14.34	11.72
n-Amyl Alcohol	0.85	8.82	16.54	21.15	21.02	11.72
Isoamyl Alcohol	.69	7.72	15.30	19.83	20.17	11.72
s-Amyl Alcohol	.18	3.09	10.90	16.48	18.39	11.72
n-Hexyl Alcohol	.62	9.70	17.97	22.41	21.56	11.72
n-Octyl Alcohol	.58	12.53	20.75	25.12	23.65	11.72

Data of Palit, 1947 (Con.)

Added Solvent	With Propylene Glycol Wt. %					
	0	20.5	40.5	60.4	80.2	100
Methylene Chloride	.02	12.11	22.89	26.29	23.99	11.72
Chloroform*	.02	16.14	26.45	28.20	26.17	11.72
Carbon Tetrachloride	.02	16.40	24.04	27.11	23.71	11.72
Acetone	.02	1.46	6.93	14.04	14.98	11.72
Ethyl Acetate	.06	4.36	10.90	15.35	16.68	11.72
Ethylene Chlorohydrin	1.80	6.02	9.86	12.72	14.09	11.72
Benzene (at 20°)	0.04	14.32	26.35	29.82	31.47	10.82

$C_{18}H$

	With Propylene Glycol Wt. %					
	0	24.5	46.3	66.0	83.8	100
Ethyl Alcohol	1.61	5.18	8.77	12.41	12.87	11.72

	With Propylene Glycol Wt. %					
	0	23	44.4	64.2	82.7	100
t-Butyl Chloride	0.12	14.90	23.57	28.44	26.01	11.72

*At 17.5% Propylene Glycol, the solubility is 14.09.

MIXTURES OF n-AMYL ALCOHOL + GLYCOLS

Glycol in Mixture	Wt. % Glycol in Solvent					
	0	20	40	60	80	100
$CH_2ClCHOHCH_2OH$	0.85	-	12.56	16.98	16.88	1.16
Monoacetin	.85	-	10.50	12.70	10.48	2.51
Glycerol	.85	-	34.62	42.68	34.36	8.53
Dibutyl Tartarate	.85	-	25.94	36.55	42.15	41.27
Phenol	.85	1.53	2.94	6.16	4.67	-

MIXTURES OF CATECHOL + ETHYL ALCOHOL

Ratio by weight:	(Catechol : Ethanol)	-	10:90	30:80	40:60
	Solubility	-	6.63	17.69	24.97

MIXTURES OF BENZENE + ALCOHOLS

Added Alcohol	Wt. % Alcohol in Solvent					
	0	20	40	60	80	100
Methanol	0.04	3.94	6.89	10.31	12.25	12.38
Cyclohexanol	.04	0.31	1.04	2.13	0.70	0.36

The freezing points of dilute sodium oleate solutions were determined by Johnston and McBain, 1942.

SODIUM 2 - R - AMIDO - 5 - R' - OXY BENZENE SULFONATES [RCONHC$_6$(OR')SO$_3$Na] $C_{18-25}H$

Temperatures at which each Salt is 5% Soluble in Water

	R= $C_{11}H_{23}$	$C_{15}H_{31}$	$C_{17}H_{35}$	$C_{17}H_{33}$
R' = CH_3	43.5°	65°	74.5°	16.5°
R' = C_2H_5	-	45.5°	-	-

(Adam and Pankhurst, 1946)

SODIUM DEOXYCHOLATE $C_{23}H_{41}OCOONa$ $C_{23}H$

SOLUBILITY OF SODIUM DEOXYCHOLATE IN WATER
(Vold and McBain, 1941)

Temperatures of Formation of Isotropic Liquid

Wt. % NaD	t°	Wt. % NaD	t°	Wt. % NaD	t°
0.0	0	49.9	35.6	74.9	114
16.0	-0.1	53.0	42.9	81.4	183
29.6	-0.9	56.2	47.2	89.5	271
38.3	-1.5	63.2	60.2	96.0	338
47.8	-2.9	69.8	63.8	100.0	approx. 362

The freezing points of dilute sodium deoxycholate solutions were determined by Johnston and McBain, 1942.

SODIUM Rosin Soaps CH

(Merril and Getty, 1948)

N wood rosin (commonly used in yellow laundry soaps) with an acid number of 162 and saponification number of 184 (average M.W. of sodium soap = 349) and a hydrogenated rosin soap of average M.W. = 343 were used. The temperatures indicate the formation of an isotropic solution.

N Wood Rosin Soap in Water		Hydrogenated Rosin Soap			
		In Water		In 0.025N NaOH	
Wt. % Soap	t°	Wt. % Soap	t°	Wt. % Soap	t°
10.1	1	10.2	69	10.1	40
20.2	7	20.0	66	27.4	70
29.1	14	34.8	98	30.0	72
40.1	26	43.9	118	34.9	77
49.1	35	50.2	132	50.2	106
59.5	48	65.5	142	54.9	112
69.5	42	59.9	147	60.0	119
80.0	62	68.3	157	67.1	122
90.6	116	80.0	117	75.4	108
		82.1	78	77.6	105
		84.8	130		

Data are also given for the solubility of hydrogenated rosin soap in sodium chloride solutions, sodium silicate solutions, and in mixtures of sodium chloride and sodium hydroxide.

CN **SODIUM CYANIDE** NaCN

100 gms. of a saturated solution of sodium cyanide in furfural contain 0.02 gms. NaCN at 25°. (Trimble, 1941).

CNS **SODIUM THIOCYANATE** NaCNS

The effect of the addition of 0.1 - 1.1 molar sodium thiocyanate on the mutual solubility of n-butyl alcohol and water is reported by Reber, McNabb, and Lucasse, 1942.

93.5 gms. NaCNS dissolve in 100 gms. of ethylenediamine at 25°. (Isbin and Kobe, 1945).

CO **SODIUM CARBONATE** Na_2CO_3

SOLUBILITY OF SODIUM CARBONATE IN WATER

(Kobe and Sheeby, 1948)

The authors made a critical survey of all the available data reported for this system, and compared temperature ranges, methods of determination, etc., and plotted the data on a large scale. The accuracy of each set of data was estimated and a smooth curve was drawn through the points. The results below were then read from the curve and their estimated accuracy is 0.4%.

t°	Solid Phase	Gm. Moles per 1000 gms. H_2O	Gms. Na_2CO_3 per 100 gms. H_2O	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Vapor Pressure mm. Hg.
-2.10	$Na_2CO_3 \cdot 10H_2O$ + Ice	0.575	6.10	5.75	-
0	"	.66	7.00	6.54	-
5	"	.84	8.90	8.2	-
10	"	1.14	12.1	10.8	-
15	"	1.55	16.4	14.1	12.3
20	"	2.09	22.2	18.1	16.9
25	"	2.77	29.4	22.7	21.4
30	"	3.70	39.2	28.2	26.8
32.00	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$	4.28	45.4	31.2	29.0
m32.96	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot H_2O$	4.71	49.9	33.3	29.5
m30	$Na_2CO_3 \cdot H_2O$	4.78	50.7	33.6	-
35.37	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot H_2O$	4.67	49.5	33.1	34.0
40	$Na_2CO_3 \cdot H_2O$	4.60	48.8	32.8	43.6
50	"	4.48	47.5	32.2	74.1
60	"	4.37	46.3	31.6	121.5
70	"	4.30	45.6	31.3	192.7
75	"	4.28	45.4	31.2	239.8
80	"	4.26	45.2	31.1	296.2
90	"	4.24	44.9	31.0	442.4
100	"	4.22	44.7	30.9	631.7
104.8	"	4.21	44.6	30.8	760.0
109	$Na_2CO_3 \cdot H_2O + Na_2CO_3$	4.20	44.5	30.8	1.15(Atm.)
110	Na_2CO_3	4.20	44.5	30.8	1.19 "
113	"	4.20	44.5	30.8	- "
120	"	4.03	42.7	29.9	1.65 "
130	"	3.86	40.9	29.0	2.25 "
140	"	3.71	39.3	28.2	3.02 "

Data of Kobe and Sheehy, 1948 (Con.)

t°	Solid Phase	Gm. Moles per 1000 gms. H_2O	Gms. Na_2CO_3 per 100 gms. H_2O	Gms. Na_2CO_3 per 100 gms. Sat. Sol.	Vapor Pressure mm. Hg.
150	Na_2CO_3	3.57	37.8	27.4	4.01 (Atm.)
160	"	3.44	36.5	26.7	5.27 "
180	"	3.16	33.5	25.1	8.67 "
200	"	2.89	30.6	23.4	13.7 "
220	"	2.56	27.1	21.3	21.0 "
240	"	2.16	22.9	18.6	30.9 "
250	"	1.95	20.7	17.1	37.0 "
260	"	1.75	18.6	15.7	44.2 "
280	"	1.32	14.0	12.3	61.7 "
300	"	0.88	9.3	8.5	83.8 "
350	"	0.19	2.0	2.0	166 "

The following data (below 30°) are those of Loewel (1851) and have not been redetermined since that time.

0	β-$Na_2CO_3 \cdot 7H_2O$	1.92	20.4	16.9	-
10	"	2.48	26.3	20.8	-
15	"	2.79	29.6	22.8	-
20	"	3.17	33.6	25.2	-
25	"	3.59	38.0	27.6	-
30	"	4.08	43.2	30.2	-
32.00	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot 10H_2O$	4.28	45.4	31.2	-
34	β-$Na_2CO_3 \cdot 7H_2O$	4.51	47.8	32.3	-
35.37	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot H_2O$	4.67	49.5	33.1	-
0	α-$Na_2CO_3 \cdot 7H_2O$	3.01	31.9	24.2	-
10	"	3.57	37.8	27.4	-
15	"	3.92	41.6	29.4	-
20	"	4.32	45.8	31.4	-

CO

SOLUBILITY OF SODIUM CARBONATE IN AMMONIA SOLUTIONS

(Akhoumov and Jeserova, 1936) (Achoumov, 1939)

The Solid Phase is $Na_2CO_3 \cdot 10H_2O$ Throughout

Wt. % NH_3 in Solvent	Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NH_3	Wt. % NH_3 in Solvent	Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NH_3
	Results at 0°			Results at 20°	
17.97	0.93	17.80	23.10	2.57	22.5
6.81	3.09	6.60	16.41	4.61	15.65
4.44	3.75	4.27	12.31	6.64	11.50
2.64	5.32	2.50	9.08	9.74	8.20
0.0	6.63	0.0	5.70	12.49	5.00
			4.44	14.50	3.80
	Results at 10°		3.46	14.63	3.30
			0.0	17.60	0.0
12.67	2.90	12.3			
8.53	5.02	8.1			
4.44	7.00	4.13			
3.99	7.22	3.70			
0.95	10.52	0.85			
0.0	11.20	0.0			

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - AMMONIA - WATER

(Akhoumov and Jeserova, 1936)

t°	Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NH_3	Solid Phase
-2.10	5.93	0.0	Ice + $Na_2CO_3 \cdot 10H_2O$
-4.3	5.44	0.70	"
-7.2	3.21	2.70	"
-8.0	1.75	4.36	"
-15.3	1.06	6.55	"
-	0.2	34.0	"
-100.3	0.0	34.34	Ice + $NH_3 \cdot H_2O$

SOLUBILITY OF SODIUM CARBONATE IN AQUEOUS AMMONIA SOLUTIONS

(Guyer, Bieler, and Orelli, 1940)

CO

The data were read from curves drawn by the authors. The results are in gms. Na_2CO_3 per 100 gms. solvent. They agree roughly with those of Achoumov (above).

t°	% NH_3 in Solvent 5	10	15	20	30	40	60	80
-30	-	-	1.1	0.9	0.5	0.5	0.5	0.5
-10	-	-	1.7	1.3	0.6	0.3	0.3	0.3
0	4.8	3.7	3.0	2.3	1.5	1.0	0.6	0.6
20	-	-	6.4	4.3	1.5	0.3	0.2	0.2

SOLUBILITY OF SODIUM CARBONATE IN SODIUM HYDROXIDE SOLUTIONS AT 50°

(Imkuna, 1949)

Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NaOH	Solid Phase
11.39	8.84	$Na_2CO_3 \cdot H_2O$
7.37	18.95	"
0.65	34.65	Na_2CO_3

Data for the system Na_2CO_3 - NaOH - NaCl - Na_2SO_4 - H_2O at 50° are also given by Imkuna, 1949.

SOLUBILITY OF SODIUM CARBONATE IN SODIUM HYDROXIDE SOLUTIONS AT 100°

(Green and Frattali, 1946)

The solid phase was found to be $Na_2CO_3 \cdot H_2O$ throughout.

Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NaOH	Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NaOH	Gms. per 100 gms. Sat. Sol. Na_2CO_3	Gms. per 100 gms. Sat. Sol. NaOH
30.8	0.0	16.6	10.5	5.5	21.9
28.9	1.1	12.8	13.8	4.8	24.2
27.5	2.0	9.4	17.1	3.6	27.0
23.8	4.6	7.6	19.0	2.7	29.7
20.2	7.6				

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - SODIUM SULFATE - WATER AT 100°

(Green and Frattali, 1946)

Saturated Solution Wt. %		Wet Residue Wt. %		Solid Phase
C	S	C	S	
30.8	0.0	-	-	C·1
29.6	2.1	84.8	0.8	"
28.8	3.4	78.7	1.9	C·1 + S.S.
28.4	3.2	54.6	21.5	"
28.6	3.4	51.4	26.8	"
24.8	5.4	32.9	58.3	S.S.
22.6	6.6	-	-	"
18.5	9.4	30.1	56.5	"
17.3	10.3	29.0	59.5	"
14.9	13.1	27.5	59.2	"
13.6	14.0	25.6	63.0	"
8.8	19.4	25.2	64.8	"
6.8	22.0	24.3	68.1	"
4.2	26.4	8.5	79.8	S.S. + S.
2.9	28.0	0.7	99.1	S
1.5	28.3	1.6	98.2	S
0.0	30.0	-	-	S

$C = Na_2CO_3$ $C·1 = Na_2CO_3·H_2O$ $S = Na_2SO_4$ S.S. = Solid Solution

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - SODIUM SULFATE - SODIUM HYDROXIDE - WATER AT 100°

(Green and Frattali, 1946)

Gms. per 100 gms. Sat. Sol.			Gms. per 100 gms. Sat. Sol.		
Na_2CO_3	Na_2SO_4	NaOH	Na_2CO_3	Na_2SO_4	NaOH
- Solid Phases $Na_2CO_3·H_2O$ + Solid Solution -					
28.5	3.2	0.0	17.9	1.9	8.6
28.0	3.1	0.9	17.4	2.0	8.7
26.4	2.9	2.5	14.0	1.7	12.0
25.4	2.8	2.6	10.8	1.2	15.4
23.3	2.6	4.2	8.0	0.8	18.9
23.8	2.5	3.8	5.0	0.6	23.2
21.5	2.3	5.4	3.2	0.5	26.9
- Solid Phases Na_2SO_4 + Solid Solution -					
4.0	26.6	0.0	2.2	17.3	7.0
3.4	24.5	1.5	2.5	11.7	11.8
3.0	21.8	3.4	2.1	7.5	16.3
2.9	21.9	3.3	2.3	4.7	21.4
2.4	19.6	5.1	1.3	2.0	30.4

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - SODIUM CHROMATE - WATER AT 35°

(Druzhinin, 1938)

Saturated Solution Wt. %		Solid Phase Wt. %		Solid Phase
Na_2CrO_4	Na_2CO_3	Na_2CrO_4	Na_2CO_3	
0.0	33.70	0.0	85.49	$Na_2CO_3 \cdot H_2O$
11.20	25.17	0.0	85.49	"
21.23	18.51	0.0	85.49	"
30.38	12.30	72.80	27.20	*[$2Na_2CrO_4 \cdot Na_2CO_3$]
37.55	7.09	73.98	26.02	["]
41.33	5.18	75.40	24.60	["]
43.73	3.32	76.00	24.00	["]
47.60	0.0	69.10	0.0	$Na_2CrO_4 \cdot 4H_2O$

*The compound $2Na_2CrO_4 \cdot Na_2CO_3$ is similar to glaserite in that it forms limited solid solutions with each of its components.

CO

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - SODIUM SULFATE - WATER AT 35°

(Druzhinin, 1938)

Saturated Solution Wt. %		Solid Phase Wt. %		Solid Phase
Na_2SO_4	Na_2CO_3	Na_2SO_4	Na_2CO_3	
33.18	0.0	100	0.0	Na_2SO_4
20.96	13.16	74.60	25.40	*[$2Na_2SO_4 \cdot Na_2CO_3$]
20.62	13.51	72.80	27.20	["]
13.44	19.61	69.50	30.50	["]
5.98	28.71	66.40	33.60	["]
0.0	33.70	0.0	85.49	$Na_2CO_3 \cdot H_2O$

*The compound $2Na_2SO_4 \cdot Na_2CO_3$ is similar to glaserite in that it forms limited solid solutions with each of its components.

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - SODIUM CHLORIDE - SODIUM SULFATE - WATER AT 100°

(Sedelnikov, 1944)

The results differ from those of Teeple (Vol. I, p. 1204).

Gms. per 100 gms. Sat. Sol.			Density	Solid Phase
Na_2CO_3	NaCl	Na_2SO_4		
-	-	-	-	C·1
31.26	-	-	1.3221	"
18.14	11.98	-	1.3122	C·1 + Cl
9.93	22.35	-	-	Cl
-	28.15	-	1.2676	Cl + S
-	25.96	4.51	1.2471	S
-	16.73	9.40	1.2572	S
-	11.93	14.46	-	S
-	-	29.9	1.3403	S + D
3.4	-	26.52	1.3441	D
11.11	-	18.75	1.3505	D
19.73	-	10.09	-	D
23.27	-	6.75	1.3873	C·1 + D
28.32		4.09		

Data of Sedel n ikov, 1944 (Con.)

Gms. per 100 gms. Sat. Sol. Na_2CO_3	NaCl	Na_2SO_4	Density	Solid Phase
25.04	3.34	4.09	1.3776	C·1 + D
16.66	12.91	2.52	1.3345	"
12.17	18.38	1.55	1.3233	"
9.91	21.95	1.21	1.3212	C·1 + D + Cl
8.87	22.36	1.29	1.3101	D + Cl
2.22	25.53	2.85	1.2779	"
0.73	25.53	4.48	1.2772	Cl + D + S
1.86	12.64	12.35	1.2790	D + S

Cl = NaCl C·1 = $Na_2CO_3 \cdot H_2O$ S = Na_2SO_4 D = n Na_2CO_3·m Na_2SO_4

Data for the system NaCl - Na_2CO_3 - Na_2SO_4 - NaOH - H_2O at 25°, 50°, and 100° were determined by Makarov and Itkina, 1944 for solutions containing 48% NaOH. CO

The system Na_2CO_3 + NaCl + Na_2SO_4 + H_2O has been reinvestigated by Makarov and Blidin, 1938. The results confirm the work of Teeple (Vol. I, p. 1204), and others, and data are given for 35°, 25°, 20°, and 15°.

EQUILIBRIUM IN THE SYSTEM SODIUM CARBONATE - SODIUM PHOSPHATE - WATER AT 25°

(Korf and Balyasnaya, 1941)

Gms. per 100 gms. Sat. Sol. Na_3PO_4	Na_2CO_3	Solid Phase	Gms. per 100 gms. Sat. Sol. Na_3PO_4	Na_2CO_3	Solid Phase
13.4	0.0	$Na_3PO_4 \cdot 12H_2O$	5.82	19.00	$Na_2CO_3 \cdot 10H_2O$
8.95	4.91	"	4.73	20.03	"
7.48	8.65	"	3.93	20.50	"
7.12	11.25	"	1.87	21.00	"
6.78	14.91	"	0.0	22.75	"
6.40	19.30	$Na_3PO_4 \cdot 12H_2O + Na_2CO_3 \cdot 10H_2O$			
6.34	19.32	"			

(See also the results of Kobe and Leipper, p. 480) under Na_3PO_4.

A detailed investigation of the five component system Na_2CO_3 - $NaHCO_3$ - Na_2SO_4 - NaCl - H_2O between 20° and 60° was carried out by Makarov and Sedel nikov, 1940.

Data for the system Na_2CO_3 - $NaHCO_3$ - NaCl - Na_2SO_4 - H_2O at 30°, 45°, and 60° have been determined by Sedel nikov, 1945 for solutions which yield $NaHCO_3$ upon crystallization.

Melting point data are given for the following systems:

$Na_2CO_3 + Na_2CrO_4$	(Vilinyanskii and Pudovkina, 1947) (diagram only)
$Na_2CO_3 + Fe_2O_3$	(Knick and Kohlmeyer, 1940)
$Na_2CO_3 + Fe_2O_3 + Na_2O$	(" " " ")
Na_2CO_3 + NaCl	(Volkov and Bergman, 1940)
Na_2CO_3 + NaF	(" " " ")
Na_2CO_3 + NaCl + NaF	(" " " ")
Na_2CO_3 + NaOH	(Seward, 1942) (Differs from previous work.) (No solid solutions were found.)

HCO SODIUM BICARBONATE $NaHCO_3$

Data for the solubility of $NaHCO_3$ in water saturated with CO_2 from 30° to 70° and from 10 to 70 atm. pressure is given by Utida, 1940.

COO SODIUM OXALATE $Na_2C_2O_4$

SOLUBILITY OF SODIUM OXALATE IN DEUTERIUM OXIDE MIXTURES AT 5°
(Noonan, 1948)

$\%D_2O$	Moles $Na_2C_2O_4$ per 100 moles solvent
91.43	0.434
100.0	.424

EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE - OXALIC ACID - WATER
(Hill, Goulden, and Hatton, 1946)

The data at 25° agree fairly well with those of Foote and Andrew (Vol. I, p. 1215).

Gms. per 100 gms. Sat. Sol. $H_2C_2O_4$	Gms. per 100 gms. Sat. Sol. $Na_2C_2O_4$	Density	Solid Phase
	Results at 0°		
3.4	0.0	1.013	H·2
3.5	0.3	1.012	H·2 + 1:1:2
3.3	0.3	1.015	1:1:2
0.3	0.8	-	1:1:2
0.2	1.3	1.007	1:1:2
0.1	2.9	-	1:1:2 + N
0.0	2.71	-	N
	Results at 60°		
31.6	0.0	1.129	H·2
31.5	1.7	1.138	H·2
31.8	2.8	1.148	H·2
31.6	3.3	1.151	H·2 + 1:1:2
30.7	3.1	1.144	1:1:2
19.3	3.0	1.091	1:1:2
9.4	3.5	1.044	1:1:2
1.7	5.8	1.034	1:1:2 + N
1.1	5.3	1.028	N
0.0	4.6	1.020	N

Gms. per 100 gms. Sat. Sol. $H_2C_2O_4$	Gms. per 100 gms. Sat. Sol. $Na_2C_2O_4$	Density	Solid Phase
	Results at 25°		
10.2	0.0	1.043	H·2
10.3	1.0	1.048	H·2 + 1:1:2
8.8	0.9	1.044	1:1:2
5.3	1.0	1.027	1:1:2
4.3	1.1	1.022	1:1:2
0.4	3.7	1.025	1:1:2 + N
0.0	3.6	1.023	N
	Results at 80°		
47.4	0.0	-	H·2
48.1	3.7	-	H·2
47.4	1.3	-	H·2
48.2	4.9	-	H·2 + 1:1:2
47.3	4.5	-	1:1:2
37.5	5.2	-	1:1:2
29.6	5.2	-	1:1:2
22.2	5.4	-	1:1:2
10.0	5.4	-	1:1:2
3.3	7.8	-	1:1:2 + N
2.4	6.9	-	N
0.9	5.9	-	N
0.0	5.3	-	N

H·2 = $H_2C_2O_4 \cdot 2H_2O$
N = $Na_2C_2O_4$
1:1:2 = $H_2C_2O_4 \cdot Na_2C_2O_4 \cdot 2H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM OXALATE - SODIUM SULFATE - WATER

(Hill, Goulden, and Hatton, 1945)

Gms. per 100 gms. Sat. Sol. Na_2SO_4	Gms. per 100 gms. Sat. Sol. $Na_2C_2O_4$	Density	Solid Phase
		Results at 25°	
22.0	0.0	1.196	$Na_2SO_4 \cdot 10H_2O$
22.0	0.5	1.200	$Na_2SO_4 \cdot 10H_2O + Na_2SO_4$
19.7	0.5	1.182	Na_2SO_4
14.7	0.8	1.155	"
5.9	1.7	1.060	"
0.0	3.6	1.023	"
		Results at 60°	
31.2	0.0	-	Na_2SO_4
30.7	0.3	1.289	$Na_2SO_4 + Na_2C_2O_4$
28.6	0.4	1.269	$Na_2C_2O_4$
20.2	0.7	1.177	"
10.1	1.7	1.088	"
0.0	4.6	1.020	"

C00

SOLUBILITY OF SODIUM OXALATE IN AQUEOUS UREA AND DIOXANE SOLUTIONS AT 18°

(Pederson, 1941)

Moles $CO(NH_2)_2$ per liter of Solvent	Moles $Na_2C_2O_4$ per liter Sat. Sol.	Moles Dioxane per liter of Solvent	Moles $Na_2C_2O_4$ per liter Sat. Sol.
0.000	0.2467	0.333	0.2095
.500	.2392	.667	.1777
1.000	.2312	1.000	.1490

At 25°, 0.064 gms. sodium oxalate dissolve in 100 gms. ethylene glycol.
" " 0.028 " " " " " " " " propylene glycol.
(Palit, 1947)

SODIUM CHLORIDE NaCl

Cl

SOLUBILITY OF SODIUM CHLORIDE IN DEUTERIUM OXIDE

(Eddy and Menzies, 1940)

[See note page 67.]

t°	Gms. NaCl per 100 gms. D_2O	t°	Gms. NaCl per 100 gms. D_2O	t°	Gms. NaCl per 100 gms. D_2O
-5	29.1	60	31.8	130	35 6
0	29.3	70	32.2	140	36.3
10	29.7	80	32.7	150	36.9
20	30.1	90	33.2	160	37.6
30	30.5	100	33.8	170	38.4
40	30.9	110	34.3	180	39.1
50	31.3	120	34.9		

SOLUBILITY OF SODIUM CHLORIDE IN WATER - DEUTERIUM OXIDE MIXTURES AT 25°

(Chang and Chu, 1939)

G = Gms. NaCl per gm. of Solvent

M = Moles NaCl per 55.51 moles of Solvent

D_2O		NaCl		D_2O		NaCl	
Wt. %	Mole %	G.	M	Wt. %	Mole	G.	M
0.0	0.0	0.3592	6.145	0.6460	0.6214	0.3245	5.938
.0002	.0002	.3589	6.140	.7571	.7371	.3186	5.899
.1749	.1601	.3502	6.096	.8999	.8900	.3110	5.849
.3989	.3738	.3377	6.018	.9959	.9954	.3056	5.811
.5233	.4969	.3311	5.979	1.0000	1.0000	.3056	5.811

For the solvent HDO the authors give G = 3324 M = 5.978

Cl

SOLUBILITY OF SODIUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 0°

(Seidel and Fischer, 1941)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
HCl	NaCl	HCl	NaCl
0	26.2	39.0	0.047
22.6	1.15	43.9	.034
26.7	0.41	44.5	.032

Data for the solubility of NaCl in water saturated with CO_2 from 30° to 70° and from 10 to 70 atm. pressure is given by Utida, 1940.

EQUILIBRIUM IN THE SYSTEM $2NaCl + H_2SO_4 \rightleftharpoons Na_2SO_4 + 2HCl(+H_2O)$ AT 25°

(Korf and Shatrobskaya, 1940)

Gms. per 100 gms. Sat. Sol.				Saturating Phases
H_2SO_4	Na_2SO_4	NaCl	HCl	
-	7.10	23.40	-	AB
13.38	22.60	10.64	-	ABC
23.03	22.86	7.14	-	ACE
29.8	20.6	5.5	-	AEF
51.25	-	5.85	0.88	AFG
54.3	-	5.4	0.80	AGH
8.82	32.50	-	-	BJ
15.00	32.50	-	-	BC
24.90	29.10	-	-	CE
29.80	26.00	-	-	EF
54.50	6.54	-	-	FG
-	-	35.70	0.87	AH
-	15.61	14.74	-	BJ
61.10	4.11	-	-	G

A = NaCl

B = Na_2SO_4

C = $Na_3H(SO_4)_2 \cdot H_2O$

E = $Na_3H(SO_4)_2$

F = $NaHSO_4 \cdot H_2O$

G = $NaHSO_4$

H = HCl

J = $Na_2SO_4 \cdot 10H_2O$

SOLUBILITY OF SODIUM CHLORIDE IN SODIUM HYDROXIDE SOLUTIONS AT 50°

(Imkuna, 1949)

Gms. NaCl per 100 gms. Sat. Sol.	18.74	11.90	3.83
" NaOH " " " " "	8.58	17.83	32.61

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE - SODIUM IODIDE - WATER

(Zhdanov and Adamenkova, 1948)

The system was studied at 0°, 25°, 50°, and 75° and the results are in excellent agreement with those of Ricci and Yanick (Vol. I, p. 1229). A large number of determinations were made at each temperature and representative data are given below.

Cl

Gms. per 100 gms. Sat. Sol. NaCl	Gms. per 100 gms. Sat. Sol. NaI	Solid Phase	Gms. per 100 gms. Sat. Sol. NaCl	Gms. per 100 gms. Sat. Sol. NaI	Solid Phase
Results at 0°			Results at 25°		
26.40	0.0	NaCl	26.45	0.0	NaCl
23.51	5.33	"	21.57	9.62	"
18.86	14.71	"	20.00	16.34	"
14.38	23.24	"	11.58	30.07	"
9.62	34.30	"	6.23	42.57	"
5.72	44.50	"	2.26	54.18	"
1.83	56.37	"	0.40	64.40	NaCl + NaI
0.74	60.63	NaCl + NaI	0.0	64.72	NaI
0.0	61.40	NaI			
Results at 50°			Results at 75°		
26.90	0.0	NaCl	27.46	0.0	NaCl
15.61	20.20	"	16.01	22.18	"
5.64	44.30	"	5.45	46.38	"
0.96	62.28	"	0.94	66.89	"
0.32	69.00	NaCl + NaI	0.23	74.49	NaCl + NaI
0.0	69.34	NaI	0.0	74.72	NaI

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE - SODIUM NITRATE - WATER ABOVE 100°

(Benrath, 1948)

t°	Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. NaCl	Solid Phase
125	38.0	3.3	$NaNO_3$ + NaCl
150	42.5	3.0	"
175	45.5	2.8	"
200	50.0	2.7	"
225	55.5	2.9	"
250	63.0	3.2	"
275	74.0	3.8	"

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE - SODIUM PHOSPHATE - WATER

(Obukhoff and Michailova, 1935)

Results at 25°

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_3PO_4	NaCl	
13.40	0.0	$Na_3PO_4 \cdot 12H_2O$
9.51	2.00	"
7.24	3.48	"
5.14	6.12	"
4.70	7.45	"
4.28	10.44	"
3.07	12.50	"
2.32	17.05	"
1.96	21.92	"
1.90	25.26	$NaCl + Na_3PO_4 \cdot 12H_2O$
0.95	25.76	NaCl
0.0	26.40	"

Results at 105°

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_3PO_4	NaCl	
49.71	0.0	Na_3PO_4
44.50	2.56	"
43.35	3.15	"
39.70	6.67	"
37.33	7.75	"
35.75	8.40	"
34.62	9.95	$Na_3PO_4 + NaCl$
33.89	10.30	NaCl
21.72	16.27	"
14.60	20.08	"
10.78	22.23	"
3.30	26.51	"
1.31	27.65	"
0.0	28.25	"

Cl

The metastable extensions of the two-phase saturation curves in the system NaCl + Na_2SO_4 + H_2O at 25° and in the quaternary system NaCl + $MgSO_4$ + H_2O were studied in detail by Levina, 1938.

EQUILIBRIUM IN THE SYSTEM $2NaCl + PbSO_4 \rightleftharpoons PbCl_2 + Na_2SO_4 (+H_2O)$

(Gromov, 1940)

Results at 25°

Gms. per 100 gms. Sat. Sol.		
NaCl	Na_2SO_4	$PbCl_2$
25.7	0.0	2.53
23.4	3.40	2.34
22.3	7.1	0.60
0.0	0.0	0.99
14.4	15.0	0.0
23.2	6.85	0.0
0	21.6	0

Results at 50°

Gms. per 100 gms. Sat. Sol.		
NaCl	Na_2SO_4	$PbCl_2$
26.0	0.0	4.92
25.0	2.04	4.49
24.2	5.37	0.62
0.0	Trace	1.76
-	-	-
23.5	5.49	0.0
-	-	-
0.0	32.0	0.0

Results at 100°

Gms. per 100 gms. Sat. Sol.			Solid Phases
NaCl	Na_2SO_4	$PbCl_2$	
26.9	0.0	12.81	A + B
25.9	1.08	12.7	A + B + C
26.3	4.76	1.43	A + C + D
-	-	-	B + C
-	-	-	D + E
25.0	4.59	0.0	A + D
-	-	-	C + E
0.0	29.6	0.0	C + D

A = NaCl B = $PbCl_2$ C = $PbSO_4$ D = Na_2SO_4 E = $Na_2SO_4 \cdot 10H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE - PLATINUM CHLORIDE - WATER

(Kurnakov and Nikitina, 1940)

See also p. 455

Gms. per 100 gms. Sat. Sol. NaCl	Gms. per 100 gms. Sat. Sol. $PtCl_4$	Solid Phase
Results at 40°		
0.0	62.38	P·5
0.11	61.47	P·5 + D·6
2.91	60.43	D·6
4.35	59.05	"
5.28	56.33	"
6.19	53.60	"
7.43	50.03	"
16.93	42.79	"
11.11	40.31	"
13.14	37.89	"
14.66	33.60	"
20.69	30.57	"
20.18	29.26	"
23.80	25.54	"
23.33	24.36	"
29.71	20.37	D·6 + N
29.05	19.79	N
28.83	18.76	N
28.50	17.48	N
24.44	19.75	N
28.14	1.78	N
27.04	0.0	N
Results at 90°		
0.0	82.50	P·3
1.85	76.55	"
3.58	76.34	"
4.83	75.66	"
6.36	72.75	P·3 + D·6
7.50	70.21	D·6
8.54	66.18	"
10.44	63.48	"
13.25	57.66	"
17.52	50.58	"
14.12	46.22	"
24.43	41.35	"
36.48	32.11	D·6 + N
35.67	29.44	N
35.61	25.69	N
35.17	22.12	N
34.48	15.70	N
33.03	8.93	N
31.24	3.79	N
28.01	0.0	N

Gms. per 100 gms. Sat. Sol. NaCl	Gms. per 100 gms. Sat. Sol. $PtCl_4$	Solid Phase
Results at 60°		
0.0	74.75	P·4
1.71	72.35	"
3.84	69.25	"
4.75	68.11	P·4 + D·6
5.15	66.54	D·6
5.98	65.41	"
6.55	61.96	"
7.75	59.67	"
8.91	56.09	"
10.64	51.80	"
11.95	48.30	"
15.23	43.90	"
16.19	40.98	"
18.64	38.04	"
21.30	34.56	"
23.69	35.13	"
25.49	33.87	"
29.04	32.48	"
30.97	31.93	"
31.87	31.73	"
33.44	31.13	D·6 + N
32.35	29.95	N
31.30	25.37	N
29.27	20.79	N
29.02	11.73	N
26.95	5.89	N
27.15	0.0	N

Gms. per 100 gms. Sat. Sol. NaCl	Gms. per 100 gms. Sat. Sol. $PtCl_4$	Solid Phase
Results at 80°		
0.0	78.60	P·3
1.89	75.88	"
3.55	73.25	"
5.19	71.01	P·3 + D·6
7.73	63.69	D·6
12.68	53.18	"
16.46	47.47	"
18.03	44.66	"
21.98	40.18	"
28.88	34.19	"
34.26	29.94	D·6 + N
34.28	25.67	N
33.09	20.92	N
33.06	17.10	N
31.99	13.92	N
30.48	7.03	N
29.26	3.57	N
27.55	0.0	N
Results at 98°		
0.0	85.11	P·3
1.36	82.64	"
2.69	80.52	"
3.33	78.89	"
4.37	78.15	"
4.60	77.29	"
5.83	76.27	P·3 + D·6
7.24	72.86	D·6
9.57	68.15	"
12.13	63.49	"
17.26	57.02	"
18.52	53.39	"
21.87	47.19	"
25.34	43.60	"
30.57	41.99	"
38.20	32.34	"
43.73	32.10	D·6 + N
42.65	27.42	N
39.61	23.14	N
38.38	18.60	N
35.26	12.01	N
31.40	1.44	N
28.40	0.0	N

P·5 = $PtCl_4 \cdot 5H_2O$

P·4 = $PtCl_4 \cdot 4H_2O$

P·3 = $PtCl_4 \cdot 3H_2O$

D·6 = $Na_2PtCl_6 \cdot 6H_2O$

N = NaCl

Data for the system NaCl - $PtCl_4$ - H_2O at 25° are given by Kumakov and Genke, 1924, and the general nature of the system is similar to those above. The freezing points of some mixtures in the system were determined by Kurnakov and Ravich, 1932.

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORIDE - SODIUM BISULFIDE - WATER AT 20°

(Bezruglyi and Kutsakov, 1939)

Gms. per 100 gms. Sat. Sol.		Solid Phases
NaCl	NaSH	
2.06	35.8	NaCl + NaSH

The boiling points of solutions saturated with NaCl + $NaClO_3$ at various pressures were determined by Linari, 1939.

SOLUBILITY OF SODIUM CHLORIDE IN LIQUID AMMONIA

(Abe and Hara, 1938; Abe, Sigatomi, and Hara, 1936)

The solubility and saturated vapor pressures were determined and the equation $L = 556.673 - 3.50294T + 0.00553498T^2$ represents the solubility of NaCl. Below -9.62° the solid phase is $NaCl \cdot 5NH_3$, and the equation for its solubility is $L' = 9.974 \times 70^{-8} \times e^{0.072188T} + 0.117$.

Cl

Temperature°:	-30	-40	-50	-60
Gms. NaCl per 100 gms. NH_3	4.204	2.168	1.144	0.633

Schattenstein and Viktorov found the solubility of sodium chloride in liquid ammonia to be 11.4 gms. per 100 gms. saturated solution at 0.1°, in excellent agreement with the results of previous workers (Vol. I, p. 1248). (1936)

100 gms. of a saturated solution in liquid sulfur dioxide at 25° contain 0.00040 gms. NaCl. (Schatenstein and Viktorov, 1937).

SOLUBILITY OF SODIUM CHLORIDE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent:	Ethylenediamine	Monoethanolamine	Ethylene Glycol
Gms. NaCl per 100 gms. Solvent	0.33	1.86	7.15

SOLUBILITY OF SODIUM CHLORIDE IN 50% ALCOHOL

(Grinberg and Zemlyakova, 1948)

Solvent	Gms. NaCl per 100 gms. Sat. Sol.
50% Alcohol	9.0
50% Alcohol Saturated with Benzene	10.1

100 gms. of a saturated solution of sodium chloride in furfural contain 0.08 gms. NaCl at 25°. (Trimble, 1941).

100 cc. of a mixture of equal volumes of ethyl ether and water saturated with HCl at 0° will dissolve 0.0012 gms. of NaCl. (Fischer and Seidel, 1941).

The effect of the addition of 0.02 - 0.08 molar sodium chloride on the mutual solubility of n-butyl alcohol and water is reported by Reber, McNabb, and Lucasse, 1942.

The specific volumes and heat capacities of solutions of NaCl in aqueous ammonium nitrate were determined by Rutskov, 1948.

SODIUM Platinum CHLORIDE Na_2PtCl_6 Cl

SOLUBILITY OF SODIUM CHLOROPLATINATE IN WATER

(Karnakov and Nikitina, 1940)

See also p. 453

t°	Gms. Na_2PtCl_6 per 100 gms. Sat. Sol.	Mole % Na_2PtCl_6	Solid Phase
0	38.70	2.44	$Na_2PtCl_6 \cdot 6H_2O$
25	44.91	3.13	"
30	47.87	3.51	"
35	49.04	3.67	"
40	50.67	3.79	"
60	57.07	5.01	"
70	59.12	5.42	"
80	65.25	6.93	"
90	68.10	7.81	"
98	71.91	9.21	"

Dextrose SODIUM CHLORIDE $(C_6H_{12}O_6)_2 \cdot NaCl \cdot H_2O$ Cl

SOLUBILITY OF DEXTROSE SODIUM CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 30°

(Ough and Peckham, 1946)

The solubility of the double salt in pure water was found to be 61.4 gms. $(C_6H_{12}O_6)_2 \cdot NaCl$ per 100 gms. sat. sol. at 30°.

Mixtures of the pure double salt, water, and concentrated hydrochloric acid were weighed into flasks which were held at 30° for ½ hour with intermittant shaking. The solutions and wet residues were analyzed for NaCl, dextrose, and HCl, and the solid was identified under the microscope.

Saturated Solution Wt. %			Solid Phase	Saturated Solution Wt. %			Solid Phase
$C_6H_{12}O_6$	NaCl	HCl		$C_6H_{12}O_6$	NaCl	HCl	
42.9	7.4	7.3	D.S.	24.7	1.4	19.3	NaCl
42.6	7.4	6.7	"	29.7	4.0	13.5	"
42.7	7.2	6.1	"	37.2	5.5	10.1	"
37.1	4.5	11.4	D.S.+NaCl	39.4	6.2	9.2	"
36.6	4.4	11.6	"	42.1	6.7	8.1	"

D.S. = $(C_6H_{12}O_6)_2 \cdot NaCl \cdot H_2O$

Melting point data are given for the following systems:

$NaCl + Na_2SO_4$ (Speranskaya, 1938)
$NaCl + NaF$ (Volkov and Bergman, 1940a) (Rassonskaya and Bergman, 1943)
$NaCl + NaF + Na_2SO_4$ (Mukimov, 1940)
$NaCl + RbNO_3 \rightleftharpoons RbCl + NaNO_3$ (Blidin, 1941)
$NaCl + Na_2CrO_4$ (Rassonskaya and Bergman, 1943)
$NaCl + NaF + Na_2CrO_4$ (" " " ")
$NaCl + NaVO_3$ (Schmitz-Dumont and Schmitz, 1944)
$NaCl + ZrCl_4$ (Belozersky and Kucherenko, 1940)
$NaCl + NaNO_3$ (Blidin, 1940)
$NaCl + ZnCl_2$ (Nikonova, Pavlenko, and Bergman, 1941)
$NaCl + ZnSO_4$ (Luzhnaya and Vereshemina, 1949)

Reactions of the salts below the melting points were studied with X-rays by Link and Wood, 1940 for the following salt pairs:

NaCl + KF NaCl + RbF NaCl + CsF

ClO SODIUM CHLORITE $NaClO_2$

SOLUBILITY OF SODIUM CHLORITE IN WATER
(Taylor, White, Vincent, and Cunningham, 1940)

Temperature °	5	17	30	45	60
Gms. $NaClO_2$ per 100 gms. Sat. Sol.	34	39	46	53	55

ClO SODIUM CHLORATE $NaClO_3$

Correction to Volume I, p. 1250.
"Solubility of Sodium Chlorate in Sodium Chloride Solutions"

In the table by Billiter, 1920, the solid phase in contact with 32% NaCl is NaCl.

In the table by Winteler, 1900, solutions containing 338 gms. $NaClO_3$ per liter and less are in equilibrium with solid NaCl.

For further data on this system see DiCapua and Scaletti, 1927, on page 1225 (Vol. I).

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORATE - SODIUM CHROMATE - WATER
(Ricci and Weltman, 1942)

Results at 19°			Results at 25°			Results at 50°		
Gms. per 100 gms. Sat. Sol.		Solid	Gms. per 100 gms. Sat. Sol.		Solid	Gms. per 100 gms. Sat. Sol.		Solid
$NaClO_3$	Na_2CrO_4		$NaClO_3$	Na_2CrO_4		$NaClO_3$	Na_2CrO_4	
48.28	0.0	A	50.06	0.0	A	55.49	0.0	A
41.91	6.43	A	43.88	5.95	A	48.49	6.36	A
33.59	14.56	A	37.06	12.45	A	36.71	18.37	A
21.57	27.00	A	29.30	20.42	A	23.55	31.45	A
15.02	35.04	A,B	21.50	28.51	A	15.81	40.80	A
10.70	37.26	B	15.65	35.18	A	13.86	43.14	A,B
5.14	40.60	B	14.43	36.43	A,B	11.54	44.21	B
2.31	42.26	B	9.82	39.47	B	6.20	47.32	B
0.0	43.63	B	7.34	41.04	B	0.0	50.66	B
			0.0	45.59				

A = $NaClO_3$ B = $Na_2CrO_4 \cdot 4H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORATE - SODIUM IODIDE - WATER AT 25°

(Ricci, 1944)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaClO_3$	NaI		$NaClO_3$	NaI	
50.10	0.0	$NaClO_3$	5.44	58.56	$NaClO_3$
38.72	12.40	"	4.32	61.68	$NaClO_3 + NaI \cdot 2H_2O$
27.62	25.23	"	2.83	62.65	$NaI \cdot 2H_2O$
18.67	36.53	"	1.43	63.67	"
10.28	48.78	"	1.22	64.00	"
7.11	54.63	"	0.0	64.80	"

EQUILIBRIUM IN THE SYSTEM SODIUM CHLORATE - SODIUM NITRATE - WATER AT 25°

(Ricci, 1944)

Gms. per 100 gms. Sat. Sol.		Density	Solid	Gms. per 100 gms. Sat. Sol.		Density	Solid
$NaClO_3$	$NaNO_3$			$NaClO_3$	$NaNO_3$		
50.10	0.0	1.432	C	32.15	27.09	1.548	N
43.98	9.26	1.481	C	27.34	29.72	1.505	N
38.82	17.47	1.517	C	20.96	33.94	1.468	N
35.72	22.65	1.528	C	13.85	38.66	1.440	N
34.28	25.94	1.553	C,N	6.93	43.27	-	N
				0.0	47.87	1.389	N

C = $NaClO_3$ N = $NaNO_3$

SOLUBILITY OF SODIUM CHLCRATE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent:	Ethylene Diamine	Monoethanol Amine	Ethylene Glycol
Gms. $NaClO_3$ per 100 gms. Solvent	52.8	19.7	16.0

SODIUM PERCHLORATE $NaClO_4$ ClO

SOLUBILITY OF SODIUM PERCHLORATE IN ORGANIC SOLVENTS AT 25°

(Isbin and Kobe, 1945)

Solvent:	Ethylene Diamine	Monoethanol Amine	Ethylene Glycol
Gms. $NaClO_4$ per 100 gms. Solvent	30.1	90.8	75.5

SODIUM CHROMATE Na_2CrO_4 CrO

SOLUBILITY OF SODIUM CHROMATE IN WATER ABOVE 100°

(Benrath, 1942)

t°	Gms. Na_2CrO_4 per 100 gms. Sat. Sol.	t°	Gms. Na_2CrO_4 per 100 gms. Sat. Sol.	t°	Gms. Na_2CrO_4 per 100 gms. Sat. Sol.
140	56	245	61	305	67
165	57	260	62	315	68
190	58	270	63	335	70
210	59	280	64	350	73
225	60	296	66	372	76

EQUILIBRIUM IN THE SYSTEM SODIUM CHROMATE - SODIUM NITRATE - WATER

(Ravich, 1948)

t°	Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. Na_2CrO_4	Solid Phase
0	24.40	19.80*	$NaNO_3$
	15.73	29.90*	"
	12.26	34.52*	"
25	30.70	18.13	"
	18.04	33.00	"
	11.72	43.28	$NaNO_3 + Na_2CrO_4 \cdot 4H_2O$
	7.08	44.73	$Na_2CrO_4 \cdot 4H_2O$
50	19.70	36.35	$NaNO_3$
	15.56	43.56	"
	13.30	46.19	"
	11.83	47.62	$NaNO_3 + Na_2CrO_4 \cdot 4H_2O$
	4.12	50.90	$Na_2CrO_4 \cdot 4H_2O$
98.5	47.30	19.34	$NaNO_3$
	37.04	30.51	"
	32.2	33.9	$NaNO_3 + Na_2CrO_4 \cdot 4H_2O$
	24.40	42.96	Na_2CrO_4
	7.75	52.43	"
-5.0	0.0	18.81	$Na_2CrO_4 \cdot 10H_2O$ + Ice
+19.7	0.0	45.05	$Na_2CrO_4 \cdot 10H_2O + Na_2CrO_4 \cdot 4H_2O$
57.2	13.97	46.81	$NaNO_3 + Na_2CrO_4 \cdot 4H_2O + Na_2CrO_4$
74.0	19.68	42.57	$NaNO_3 + Na_2CrO_4$
98.5	32.17	34.41	"
50.0	11.83	47.62	$NaNO_3 + Na_2CrO_4 \cdot 4H_2O$
25.0	11.72	43.28	"
14.8	12.58	36.35	$NaNO_3 + Na_2CrO_4 \cdot 4H_2O + Na_2CrO_4 \cdot 10H_2O$
9.0	21.70	24.30	$NaNO_3 + Na_2CrO_4 \cdot 10H_2O$
-8.0	10.70	12.00	$Na_2CrO_4 \cdot 10H_2O$ + Ice
-10.0	34.10	7.11	$Na_2CrO_4 \cdot 10H_2O + NaNO_3$
-18.5	34.70	3.51	$NaNO_3 + Na_2CrO_4 \cdot 10H_2O$ + Ice

*Metastable

EQUILIBRIUM IN THE SYSTEM SODIUM CHROMATE - SODIUM MOLYBDATE - WATER

(Cadbury, 1945)

Saturated Solution Wt. % Na_2CrO_4	Saturated Solution Wt. % Na_2MoO_4	Wet Residue Wt. % Na_2CrO_4	Wet Residue Wt. % Na_2MoO_4	Hydration of Solid Solution
		Results at 0°		
		-	-	10
23.50	0.0	42.39	4.94	10
18.73	7.31	30.40	17.69	10
11.24	19.24	22.47	26.49	10
8.83	23.30	14.01	35.75	10
8.35	23.86	7.24	44.08	10
5.04	26.81	-	-	10
0.0	30.35			

Data of Cadbury, 1945 (Con.)

Saturated Solution Wt. %		Wet Residue Wt. %		Hydration of Solid Solution
Na_2CrO_4	Na_2MoO_4	Na_2CrO_4	Na_2MoO_4	
		Results at 8°		
30.50	0.0	-	-	10
25.49	7.16	41.49	4.64	10
22.44	11.56	38.12	7.92	10
19.36	16.45	35.12	12.06	10
13.07	25.35	23.76	23.64	10
20.59	19.64	23.91	23.09	10
15.22	24.27	15.55	31.37	10
9.44	29.25	10.94	37.44	10
3.21	33.97	3.63	47.18	10
0.0	36.83	-	-	10
		Results at 15°		
37.78	0.0	-	-	10
33.57	5.80	45.73	1.67	10
25.97	16.50	36.74	11.60	10
21.23	20.66	11.13	54.52	2
10.62	29.54	1.84	78.61	2
0.0	39.15	-	-	2
		Results at 19°		
43.09	0.0	-	-	10
40.85	3.20	45.65	2.37	10
38.55	6.45	44.21	4.30	10
43.82	0.0	-	-	6
41.92	2.14	58.22	1.42	6
37.76	6.80	56.49	4.12	6
44.80	0.35	67.28	0.68	4
43.68	1.37	63.88	3.20	4
42.42	2.82	61.60	5.49	4
38.00	6.96	17.63	55.58	2
24.71	17.31	4.08	78.22	2
0.0	29.28	-	-	2
		Results at 22°		
44.98	0.0	-	-	6
42.98	2.07	58.15	1.32	6
40.42	5.10	55.76	3.53	6
40.64	5.08	56.91	10.97	4
40.15	5.70	53.50	12.22	4
40.18	5.95	53.10	15.23	4
		Results at 25°		
45.85	0.0	-	-	6
45.38	0.60	59.55	0.05	6
44.55	1.40	59.37	0.31	6
44.53	1.33	64.90	2.80	4
42.85	3.09	61.00	6.01	4
40.30	5.89	53.55	16.07	4
41.12	4.89	24.10	53.97	2
20.20	21.93	10.91	54.41	2
0.0	39.56	-	-	2

CrO

EQUILIBRIUM IN THE SYSTEM SODIUM CHROMATE - SODIUM SULFATE - WATER AT 25°

(Marakov and Druzhinin, 1937)

The results are also given in mole %.

Saturated Solution Wt. %		Solid Phase		
Na_2SO_4	Na_2CrO_4	Na_2SO_4	Na_2CrO_4	
21.92	0.0	44.10	0.0	S.S.
20.76	1.56	43.95	0.50	S.S.
20.12	2.53	43.66	.80	S.S.
18.96	4.02	43.40	1.10	S.S.
18.62	4.95	43.25	1.30	S.S.
16.49	9.66	43.35	2.60	S.S.
14.71	14.19	41.60	3.60	S.S.
13.87	14.85	41.90	3.25	S.S.
13.91	16.22	40.95	4.50	S.S.
10.69	23.72	37.95	8.80	S.S.
10.02	26.13	37.30	9.50	S.S.
8.32	31.70	31.00	15.50	S.S. + S
8.49	31.43	-	-	S.S. + S
8.68	31.84	-	-	S.S. + S
8.03	32.34	98.70	1.30	S
6.75	34.75	-	-	S
4.44	38.59	99.25	0.75	S
4.38	39.22	-	-	S
2.79	42.48	97.75	2.25	S
2.20	43.80	58.60	25.25	S + Cr·6
2.29	43.83	18.00	48.70	S + Cr·6
2.44	43.26	3.50	58.30	S + Cr·6
2.18	43.57	10.30	53.70	S + Cr·6
2.12	43.69	8.90	56.00	S + Cr·6
2.24	43.49	2.25	58.75	S + Cr·6
2.20	43.33	0.60	59.00	S + Cr·6
1.08	44.61	0.0	60.00	Cr·6
0.0	45.76	0.0	60.00	Cr·6

CrO

S.S. = Solid Solution of $Na_2CrO_4 \cdot 6H_2O$ in $Na_2SO_4 \cdot 10H_2O$

S = Na_2SO_4

Cr·6 = $Na_2CrO_4 \cdot 6H_2O$

100 gms. of a saturated solution of sodium chromate in furfural at 25° contain 0.05 gms. $Na_2CrO_4 \cdot 4H_2O$. (Trimble, 1941).

Melting point data are given for:

Na_2CrO_4 + NaF	(Rassonskaya and Bergman, 1943)
Na_2CrO_4 + Na_2SiO_3	(Vilinyanskii and Pudovkina, 1947) (Diagram only)

SODIUM DICHROMATE $Na_2Cr_2O_7$

SOLUBILITY OF SODIUM DICHROMATE IN WATER
(Hartford, 1941)

t°	Gms. $Na_2Cr_2O_7$ per 100 gms. Sat. Sol.		t°	Gms. $Na_2Cr_2O_7$ per 100 gms. Sat. Sol.		t°	Gms. $Na_2Cr_2O_7$ per 100 gms. Sat. Sol.	
0.0	0.0	I	-45.4	60.84	2	46.1	69.21	2
-5.0	22.05	I	-8.0	61.73	2	57.2	71.38	2
-10.6	37.47	I	0.0	62.17	2	60.0	71.76	2
-19.7	48.50	I	5.0	62.49	2	68.3	73.76	2
-35.7	57.32	I	25.0	65.01	2	74.4	75.65	2
-44.0	59.96	I	32.2	66.06	2	84.6	79.18	2,0
-48.2	60.77	I,2	40.6	67.98	2	90.1	79.65	0
						95.0	80.01	0

I = Ice 2 = $Na_2Cr_2O_7 \cdot 2H_2O$ 0 = $Na_2Cr_2O_7$

Additional data for the solubility of sodium dichromate in water are given by Yuskevich and Karzhavin, 1926.

SODIUM FLUORIDE NaF F

SOLUBILITY OF SODIUM FLUORIDE IN WATER
(Tananaev, 1941)

t°	Gms. NaF per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. NaF per 100 gms. Sat. Sol.	Solid Phase
-0.75	1.00	Ice	0	3.95	NaF
-1.60	2.00	"	20	4.10	"
-2.45	3.00	"	40	4.35	"
-3.40	3.82	"	80	4.48	"
-3.50	3.92	Ice + NaF	94	4.73	"

EQUILIBRIUM IN THE SYSTEM SODIUM FLUORIDE - HYDROGEN FLUORIDE - WATER

(Tananaev, 1941)

F

Gms. per 100 gms. Sat. Sol. NaF	Gms. per 100 gms. Sat. Sol. HF	Solid Phase
Results at 0°		
3.95	0.0	NaF
4.34	0.10	NaF + NaF·HF
3.71	0.27	NaF·HF
2.34	0.45	"
1.27	3.95	"
1.00	9.27	"
0.92	15.30	"
1.34	22.60	"
2.98	38.96	"
3.57	40.90	"
4.63	43.96	"
5.45	45.46	"
6.82	47.87	"
8.74	50.00	"
9.73	51.25	"
10.18	51.86	"
11.67	53.14	"
13.71	54.21	"
15.63	55.41	"
17.20	56.88	"
18.91	57.10	"
18.97	57.22	"
18.77	57.30	NaF·2HF
19.51	58.50	"
20.10	59.01	"
20.62	59.56	"
21.24	59.94	"
21.30	60.46	NaF·3HF
20.94	61.20	"
20.68	62.02	"
20.73	62.27	"
21.28	63.20	"
20.18	64.06	NaF·4HF
18.54	65.72	"
17.67	67.26	"
17.37	68.11	"
16.93	68.95	"
16.87	69.40	"
16.72	70.40	"
16.70	71.50	"
16.61	72.57	"
17.25	73.15	"
18.22	75.70	"
Results at 20°		
4.10	0.0	NaF
4.03	0.22	"
4.12	0.39	"
4.32	0.53	NaF + NaF·HF
3.26	0.69	NaF·HF
2.75	0.94	"
9.57	1.18	"
1.76	5.70	"
1.46	12.60	"
1.51	16.74	"
1.61	19.40	"
1.93	26.10	"
2.20	29.63	"
2.46	30.92	"
3.34	36.94	"
3.67	37.77	"
4.79	41.88	"
9.95	50.00	"
24.07	60.00	NaF·3HF
Results at 40°		
4.35	0.0	NaF
4.40	0.47	"
4.56	0.94	"
4.14	1.11	NaF + NaF·HF
3.74	1.20	NaF·HF
3.33	1.59	"
2.73	2.75	"
2.77	6.45	"
2.58	10.94	"
2.65	15.50	"
2.63	20.78	"
2.98	27.18	"
4.75	38.08	"
10.40	50.20	"

F

SODIUM Beryllium FLUORIDE Na_2BeF_4

SOLUBILITY IN WATER

(Vorobieva and Novoselova, 1948)

The salt was found to exist in both rhombic and monoclinic forms, and some of the results of Novoselova (Vol. I, p. 1260) are shown to be metastable.

t°	Gms. Na_2BeF_4 per 100 gms. Sat. Sol.	Solid Phase
-0.13	0.24	Ice
- .267	.48	"
- .39	.93	"
- .44	1.01	Ice + Na_2BeF_4
- .52	1.26	Ice (Metastable)
- .56	1.30	" (")
- .59	1.44	" (")

t°	Gms. Na_2BeF_4 per 100 gms. Sat. Sol.	Solid Phase
0	1.31	Na_2BeF_4 (Monoclinic)
0	1.02	" (Rhombic)
20	1.37	" (")
20	1.70	" (Monoclinic)
40	1.88	" (Rhombic)
60	2.19	" (")
80	2.55	" (")
94	2.75	" (")

F

SODIUM BIFLUORIDE NaHF

At 25°, 2.78 gms. of NaHF dissolve in 100 gms. ethylene glycol.

(Palit, 1947)

F SODIUM Silico FLUORIDE (Sodium Fluosilicate) Na_2SiF_6

SOLUBILITY OF SODIUM FLUOSILICATE IN WATER

The data of Ansonov and Chirkov, 1933 (1), Chepelevetski and Bolz, 1937 (2), Kleiner, 1944 (3), Nikolaev, Ivanov, and Koltipin, 1936 (4), and Caillat, 1945 (5) were plotted with those of Carter, Stolba, and Worthington and Haring (Vol. I, p. 1261), and an average curve was drawn through all the points.

t°	Gms. Na_2SiF_6 per 100 gms. Sat. Sol.		t°	Gms. Na_2SiF_6 per 100 gms. Sat. Sol.	
	Individual Results	Average Curve		Individual Results	Average Curve
0	0.40 (3)	0.41	40	1.05 (2)	
10	.53 (4)	.53		0.99 (3)	1.02
15	.57 (3)	.60	45	1.14 (5)	1.12
16	.62 (5)	.61	50	1.27 (4)	1.22
17.5	.65 (1)	.63	55	1.33 (5)	1.33
20	.64 (3)		60	1.49 (2)	
	.66 (4)	.67		1.42 (5)	1.44
25	.76 (5)		70	-	1.68
	.72 (3)	.75	80	1.95 (2)	1.92
30	-	.84	90	-	2.17
35	.96 (5)	94	100	-	2:42

SOLUBILITY OF SODIUM FLUOSILICATE IN HYDROCHLORIC ACID SOLUTIONS

(Kleiner, 1944)

Gms. HCl per 100 gms. Sat. Sol.	Gms. Na_2SiF_6 per 100 gms. Sat. Sol. Densities are d_{20}^t				
	0°	15°	20°	25°	40°
0	0.39	0.58	0.64	0.72	0.99
d =	-	-	-	-	-
2.1	0.80	1.11	1.23	1.30	1.69
d =	1.0178	1.0191	1.0201	1.0211	-
4.1	0.99	1.28	1.35	1.41	1.80
d =	1.0292	1.0303	1.0310	1.0321	-
6.0	0.96	1.23	1.30	1.37	1.71
d =	-	-	1.0410	1.0408	-
8.1	0.82	1.09	1.17	1.25	1.55
d =	1.0505	1.0501	1.0495	1.0491	-
10.1	0.68	0.92	1.02	1.12	1.37
d =	1.0601	1.0596	1.0592	1.0589	-
12.1	0.53	0.74	0.85	0.94	1.17
d =	1.0699	1.0684	1.0678	1.0671	-
14.0	0.39	0.55	0.66	0.76	0.97
d =	1.0790	1.0771	1.0760	1.0749	-
16.1	0.31	0.42	0.52	0.60	0.73
d =	1.0893	1.0854	1.0850	1.0848	-
19.6	0.30	0.40	0.45	0.52	0.61
d =	-	1.1034	1.1026	1.1020	-

SOLUBILITY OF SODIUM SILICOFLUORIDE IN HYDROCHLORIC ACID SOLUTIONS CONTAINING SODIUM CHLORIDE AT 20°

(Kleiner, 1944)

Gms. per 100 gms. Sat. Sol.			Density	Solid Phase
HCl	NaCl	Na_2SiF_6		
0.0	2.06	0.07	1.0150	F
2.03	1.97	.19	1.0240	F
4.07	1.91	.21	1.0356	F
5.92	1.99	.20	1.0456	F
11.82	1.97	.12	1.0734	F
15.15	1.98	.11	1.0905	F
18.94	2.06	.07	1.1095	F
0.0	26.35	.013	1.2037	F + C
1.61	23.45	.034	1.1913	"
3.20	21.09	.046	1.1794	"
4.80	18.80	.043	1.1685	"
7.66	14.67	.043	1.1522	" F
12.01	9.35	.040	1.1312	"
13.46	7.85	.040	1.1265	"
17.67	4.03	.041	1.1194	"

F = Na_2SiF_6 C = NaCl

SOLUBILITY OF SODIUM FLUOSILICATE IN HYDROFLUORIC ACID SOLUTIONS

(Nikolaev, Ivanov, and Koltipin, 1936)

0°		10°		20°		50°	
Wt. % HF	Gms. Na_2SiF_6 per 100 gms. Sat. Sol.	Wt. % HF	Gms. Na_2SiF_6 per 100 gms. Sat. Sol.	Wt. % HF	Gms. Na_2SiF_6 per 100 gms. Sat. Sol.	Wt. % HF	Gms. Na_2SiF_6 per 100 gms. Sat. Sol.
0.1	0.46	0	0.53	0	0.66	0	1.27
5.27	.63	5.65	.69	5.0	.84	-	-
15.53	.88	15.7	.89	15.0	.99	16.0	1.35
21.2	.90	21.2	.96	19.56	1.06	20.6	1.40
26.53	1.03	25.6	1.00	21.0	1.15	26.48	1.42

SOLUBILITY OF SODIUM FLUOSILICATE IN SODIUM CHLORIDE - PHOSPHORIC ACID SOLUTIONS

(Chepelevetski and Bolz, 1937)

Results are expressed as gms. Na_2SiF_6 per 100 gms. sat. sol.

Wt. % P_2O_5	Wt. % NaCl at 40°			Wt. % NaCl at 80°		
	0	2	4	0	2	4
1	1.10	-	-	2.07	-	-
5	1.15	-	-	2.01	-	-
10	1.09	0.196	0.105	1.9	0.73	0.38
15	0.95	.181	.100	1.75	.59	.34
20	.78	.127	.067	1.45	.47	.24
25	.61	.066	.043	1.25	.38	.18
With 0.6% Al_2O_3 added, the Solubility is increased:						
10	-	-	0.33	-	-	0.90
20	-	-	.25	-	-	.62
25	-	-	.19	-	-	.48

F Melting point data are given for:

$NaF + YF_3$	(Dergunov, 1948)
$NaF + AlF_3$	(")
$NaF + LaF_3$	(")
$NaF + NaVO_3$	(Schmitz-Dumont and Schmitz, 1944)

The systems $NaF + UF_3$, $NaF + ThF_4$ and $NaF + LaF_3$ were studied by means of X-rays by Zachariasen, 1948.

Reactions of the salts below their melting points were studied with X-rays by Link and Wood, 1940 for the following pairs:

NaF + KCl	NaF + KBr	NaF + KI
NaF + RbCl	NaF + RbBr	NaF + RbI
NaF + CsCl	NaF + CsBr	NaF + CsI

I SODIUM IODIDE NaI

SOLUBILITY OF SODIUM IODIDE IN WATER AND DEUTERIUM OXIDE

(Eddy and Menzies, 1940)

[See note page 67 .]

A new hydrate was found which is metastable with respect to the dihydrate, but its composition was not determined.

In H_2O			In D_2O		
t°	Gms. NaI per 100 gms. H_2O	Solid Phase	t°	Gms. NaI per 100 gms. D_2O	Solid Phase
45	27.36	$NaI \cdot H_2O$(m)	0	14.14	$NaI \cdot 2D_2O$
50	27.90	" (m)	10	14.92	"
55	28.52	" (m)	20	15.89	"
58.2	28.89	" (m)	30	17.06	"
60.0	29.15	$NaI \cdot H_2O + NaI$(m)	40	18.53	"
60	25.73	$NaI \cdot 2H_2O$	50	20.47	"
65	27.71	"	60	23.26	"
55	29.07	NaI(m)	66.0	25.85	$NaI \cdot 2D_2O + NaI$
60	29.16	" (m)	45	24.30	$NaI \cdot xD_2O$(m)
65	29.27	" (m)	50	24.82	" (m)
68.2	29.34	$NaI + NaI \cdot 2H_2O$	55	25.38	" (m)
75	29.48	NaI	58.2	25.73	$NaI \cdot xD_2O + NaI$(m)
110	30.53	"	55	25.68	NaI(m)
120	30.95	"	60	25.76	" (m)
130	31.38	"	70	25.93	"
140	31.91	"	80	26.14	"
150	32.45	"	90	26.38	"
160	33.03	"	100	26.66	"
170	33.67	"	110	26.99	"
180	34.34	"			

(m) = Metastable

SODIUM IODIDE NaI

FREEZING POINTS IN THE SYSTEM SODIUM IODIDE - WATER

(Briggs and Geigle, 1940)

The results are quoted by Briggs and Geigle and include data by Jones, et al (1907), Rudorff (1862), deCappet (1883), and Etard (1894).

t°	Gms. NaI per 100 gms. Sat. Sol.	Solid	t°	Gms. NaI per 100 gms. Sat. Sol.	Solid
-0.85	3.74	Ice(3)	-23.5	41.9	Ice(1)
-1.9	7.48	" (3)	-26.8	44.2	" (1)
-2.44	9.34	" (2)	-29.5	46.00	" (2)
-4.25	14.59	" (3)	-30.6	46.5	" (1)
-5.37	17.44	" (2)	-31.5	47.1	Ice + $NaI \cdot 5H_2O$(1)
-5.6	18.7	" (1)	-36.1	49.0	Ice(m)(1)
-8.70	24.55	" (2)	-26.5	49.0	$NaI \cdot 5H_2O$(1)
-9.75	26.50	" (3)	-20	51.5	" (5)
-12.72	30.84	" (2)	-18.5	53.3	" (1)
-17.8	37.2	" (1)	-15.2	56.93	" (4)
-18.0	36.46	" (2)	-14.0	57.2	" (1)
-23.0	41.55	" (2)	-12.3	60.2	" (1)

(1) Briggs and Geigle (2) Jones (3) Rudorff (4) deCoppet
(5) Etard (m) = Metastable

SOLUBILITY OF SODIUM IODIDE IN SODIUM HYDROXIDE SOLUTIONS AT 20°

(Pomeroy and Kirschman, 1944)

Moles per liter		Density	Moles per liter		Density
NaOH	NaI		NaOH	NaI	
0.0	8.14	1.910	8.20	6.92	1.981*
0.97	7.74	1.888	8.66	6.76	1.972
1.40	7.69	1.881	9.29	6.54	1.965
1.77	7.34	1.871	9.61	6.47	1.962
2.62	7.11	1.872	9.70	6.34	1.948
3.72	6.76	1.860	10.36	6.24	1.956
4.04	6.63	1.856	11.38	5.99	1.952
4.90	6.48	1.865	12.71	5.76	1.958
5.45	6.40	1.870	13.49	5.64	1.958
6.38	6.36	1.885	13.95	5.50	1.953
7.10	6.44	1.905	14.24	5.52	1.959
7.24	6.41	1.908	14.41	5.45	1.959
7.54	6.49	1.922	15.21	5.42	1.970
7.74	6.66	1.942			

*In equilibrium with $NaI \cdot 2H_2O$ + NaI. At concentrations of NaOH less than 8.20 M, the solid phase is $NaI \cdot 2H_2O$, and above 8.20 M it is NaI.

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE - IODINE - WATER

The system has been studied from the eutectic temperature to 113.5° (the NaI-I eutectic) by Briggs, Geigle, and Eaton, 1941, at 0° by Cheesman, Duncan, and Harris, 1940 and at 25° by Strelnikov, 1933 with good agreement among the various results. At 25° the only solid phases

are $NaI \cdot 2H_2O$ and Iodine and the invariant solution contains 25.3 Wt. % NaI and 63.8% I_2. Three polyiodides are found in the polythermal system and the formulas found by C. D. and H. are simpler than those of B. G. and E., although the % composition of each compound was found to be about the same in both investigations. No Triodide is formed, in contrast to many other univalent metals.

Results at 0° (C. D. and H.)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
NaI	I		NaI	I	
61.4	0.0	$NaI \cdot 2H_2O$	30.8	49.5	$NaI_4 \cdot 2H_2O$
44.9	27.5	"	28.7	52.6	"
38.4	38.2	$NaI \cdot 2H_2O + NaI_2 \cdot 3H_2O$	27.5	54.5	"
36.1	41.6	$NaI_2 \cdot 3H_2O$	26.7	55.8	$NaI_4 \cdot 2H_2O + I_2$
35.7	42.3	"	24.7	45.1	I_2
34.9	43.9	$NaI_2 \cdot 3H_2O + NaI_4 \cdot 2H_2O$	21.8	31.9	"
33.2	46.0	$NaI_4 \cdot 2H_2O$	17.7	21.2	"

Binary and Ternary Transition Points (B., G. and E.)

In addition to this data the authors report the results of over 100 determinations in the polythermal system of solutions in equilibrium with two or more solids.

t°	Gms. per 100 gms. Sat. Sol.		Solid Phases
	I	NaI	
0	Trace	0	Ice + Iodine
113.5	99.8	0.2	NaI + Iodine
-31.5	0	47.1	Ice + $NaI \cdot 5H_2O$
-12.3	0	60.2	$NaI \cdot 5H_2O + NaI \cdot 2H_2O$
68.1	0	74.8	$NaI \cdot 2H_2O$ + NaI
-33.3	22.3	37.3	Ice + Z + $NaI \cdot 5H_2O$
-24.7	42.2	25.6	Ice + Z + Iodine
-13.9	9.7	54.3	$NaI \cdot 2H_2O$ + Y + $NaI \cdot 5H_2O$
-21.8	27.7	39.8	Y + Z + $NaI \cdot 5H_2O$
-10.1	47.0	31.1	X + Y + Z
2.0	45.1	34.5	X + Y + $NaI \cdot 2H_2O$
-7.0	53.7	27.1	X + Z + Iodine
16.4	60.5	26.3	X + $NaI \cdot 2H_2O$ + Iodine
37.6	66.1	24.3	NaI + $NaI \cdot 2H_2O$ + Iodine

X = $Na_4I_{14} \cdot 13\text{-}15H_2O$ Y = $Na_5I_{11} \cdot 17\text{-}19H_2O$ Z = $Na_2I_8 \cdot 10\text{-}11H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM IODIDE - LEAD IODIDE - WATER

(Roger, 1944)

Refractive indices were determined for many of the solutions at 25°. A complete phase diagram is drawn for the system at both 0° and 25°.

Gms. per 100 gms. Sat. Sol. PbI_2	Gms. per 100 gms. Sat. Sol. NaI	Density	Solid Phase	
		Results at 0°		
0.041	0.0		PbI_2	
.0006	2.27		"	
32.94	41.04		$PbI_2 + PbI_2 \cdot NaI \cdot 4H_2O$	
30.85	43.59		$PbI_2 \cdot NaI \cdot 4H_2O + PbI_2 \cdot 2NaI \cdot 6H_2O$	
24.96	47.92		$PbI_2 \cdot 2NaI \cdot 6H_2O + NaI \cdot 2H_2O$	I
0.0	61.59		$NaI \cdot 2H_2O$	
		Results at 25°		
0.077	0.0		PbI_2	
.0555	0.0546		"	
.0288	.1180		"	
.0209	.2127		"	
.0071	.2881		"	
.0042	.4729		"	
.0022	1.045		"	
.0026	3.16*	1.023	"	
.0054	5.12	-	"	
.0262	8.29	-	"	
5.43	33.44**	1.417	"	
11.65	36.82	1.630	"	
22.00	39.21	1.909	"	
27.70	40.44	2.132	"	
30.42	41.61	2.272	"	
32.88	41.91	2.427	"	
34.59	42.57	2.542	$PbI_2 + PbI_2 \cdot NaI \cdot 4H_2O$	
34.09	42.82	2.526	$PbI_2 \cdot NaI \cdot 4H_2O$	
32.02	43.29	2.428	"	
31.82	43.56	2.433	"	
31.34	44.38	2.475	"	
31.38	45.61	2.499	$PbI \cdot NaI \cdot 4H_2O + PbI_2 \cdot 2NaI \cdot 6H_2O$	
31.04	45.92	2.496	$PbI_2 \cdot 2NaI \cdot 6H_2O$	
30.49	46.62	2.490	"	
29.98	47.05	2.481	"	
26.69	47.71	2.492	"	
29.41	47.75	2.495	$PbI_2 \cdot 2NaI \cdot 6H_2O + NaI \cdot 2H_2O$	
26.38	49.79	2.426	$NaI \cdot 2H_2O$	
21.18	52.45	2.303	"	
11.22	58.40	2.119	"	
5.97	61.23	2.014	"	
0.0	64.58	1.919	"	

100 gms. of a saturated solution in liquid sulfur dioxide contain 1.59 gms. NaI at 25°. (Shatenstein and Viktorov, 1937).

Reactions of the salts below the melting points were studied with X-rays by Link and Wood, 1940 for the following pairs:

NaI + KF NaI + CsF NaI + RbF

SOLUBILITY OF SODIUM IODIDE IN ACETONE
(Evertz and Livingston, 1949)

The results are in accord with those of Macy and Thomas and Wadsworth and Dawson, (Vol. I, p. 1268).

I

t°	Gms. NaI per 100 gms. Sat. Sol.	t°	Gms. NaI per 100 gms. Sat. Sol.	t°	Gms. NaI per 100 gms. Sat. Sol.
20.7	23.75	-21.5	5.38	-62.6	1.77
0.9	11.60	-43.6	2.51	-76.5	1.54
0.5	10.83	-67.3	2.20		

SOLUBILITY OF SODIUM IODIDE IN ORGANIC SOLVENTS AT 25°
(Isbin and Kobe, 1945)

Solvent:	Ethylene Diamine	Monoethanolamine	Ethylene Glycol
Gms. NaI per 100 gms. Solvent	34.6	22.0	107.4

3% Sodium Iodide by weight dissolves in acetonitrile at 25°. (Pleskov, 1948).

The effect of the addition of 0.05 - 0.30 molar sodium iodide on the mutual solubility of n-butyl alcohol and water is reported by Reber, McNabb, and Lucasse, 1942.

MoO **SODIUM MOLYBDATE** Na_2MoO_4

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - MOLYBDIC OXIDE - WATER AT 24°
(Bye, 1943, 1945)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2O	MoO_3		Na_2O	MoO_3	
*40.6	0.0	$NaOH \cdot H_2O$	6.18	30.37	$Na_2Mo_2O_7 \cdot 6H_2O$
40.3	0.206	$NaOH \cdot H_2O + Na_2MoO_4$	6.46	33.47	$Na_2Mo_2O_7 \cdot 6H_2O +$
38.7	.216	Na_2MoO_4			$Na_2Mo_3O_{10} \cdot 7H_2O$
36.9	.228	"	5.95	30.85	$Na_2Mo_3O_{10} \cdot 7H_2O$
33.7	.393	"	5.17	26.80	"
32.6	.465	$Na_2MoO_4 + Na_2MoO_4 \cdot 2H_2O$	4.84	24.88	"
30.7	.664	$Na_2MoO_4 \cdot 2H_2O$	4.57	24.05	"
28.26	.955	"	3.80	20.0	"
20.98	4.86	"	2.56	13.82	"
17.77	9.92	"	2.21	11.88	"
15.40	15.87	"	2.09	11.35	"
13.58	21.13	"	1.605	9.30	"
*11.85	27.55	"	*1.09	7.51	"
11.82	27.50	$Na_2MoO_4 \cdot 2H_2O +$ $Na_2Mo_2O_7 \cdot 6H_2O$	0.992	8.30	$Na_2Mo_3O_{10} \cdot 7H_2O$ $+ Na_2Mo_4O_{13} \cdot 7H_2O$
8.86	20.72	$Na_2Mo_2O_7 \cdot 6H_2O$	*0.910	8.50	$Na_2Mo_4O_{13} \cdot 7H_2O$
8,81	20.82	"	.951	8.49	
6.52	15.75	"	.605	5.58	$Mo_6O_{19}Na_{1+\alpha}H_{1-\alpha} \cdot 5H_2O$
5.43	14.80	"	.849	7.95	"
4.89	17.30	"	.88	8.18	"
5.30	21.65	"	.69	6.41	
5.80	27.0				

Data of Bye, 1943, 1945 (Con.)

Gms. per 100 gms. Sat. Sol.*		Solid Phase
Na_2O	MoO_3	
.61	5.65	$Mo_6O_{19}Na_{1+\alpha}H_{1-\alpha}\cdot 5H_2O$
.343	3.095	"
.202	1.82	"
.032	0.455	"
The following are metastable equilibria		
11.80	31.55	$Na_2MoO_4\cdot 2H_2O + 3:7:22$
11.58	31.23	$3Na_2O\cdot 7MoO_3\cdot 22H_2O$
9.35	29.3	"
7.90	30.0	"
7.41	33.1	"
7.20	35.6	"
7.25	36.45	"
7.25	37.1	$3:7:22 + Na_2Mo_3O_{10}\cdot 7H_2O$

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2O	MoO_3	
*7.31	39.6	$Na_2Mo_3O_{10}\cdot 7H_2O$
*0.0	0.126	MoO_3
.293	3.06	"
.615	5.99	"
.655	6.28	"
.903	8.66	$MoO_3 + Na_2Mo_4O_{13}\cdot 7H_2O$
*0.0	0.167	$MoO_3\cdot 2H_2O$
.049	.682	"
.125	1.44	"
.27	3.03	"
.54	5.88	"
.87	9.31	$MoO_3\cdot 2H_2O + Na_2Mo_4O_{13}\cdot 7H_2O$
*0.0	0.253	$MoO_3\cdot H_2O$
.28	4.21	"
.15	2.23	"

*Represents the solubility of the substance in pure water.

MoO

SOLUBILITY OF SODIUM MOLYBDATE IN MOLYBDIC OXIDE SOLUTIONS AT 25°

(Ricci and Doppelt, 1944)

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2MoO_4	MoO_3	
39.42	0.0	$Na_2MoO_4\cdot 2H_2O$
39.48	.00	$Na_2MoO_4\cdot 2H_2O + Na_2Mo_2O_7\cdot 6H_2O$
38.78	.00	$Na_2Mo_2O_7\cdot 6H_2O$
37.66	.00	"
36.66	.010	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2MoO_4	MoO_3	
36.38	.00	$Na_2Mo_2O_7\cdot 6H_2O$
33.44	.026	"
32.54	.018	"
30.85	.047	"
28.81	.083	"
24.82	.320	"

EQUILIBRIUM IN SYSTEMS OF SODIUM MOLYBDATE WITH SODIUM HALATES AT 25°

(Ricci and Linke, 1947)

$Na_2MoO_4 + NaBrO_3 + H_2O$

Gms. per 100 gms. Sat. Sol.		Density
Na_2MoO_4	$NaBrO_3$	
39.38	0.0	1.432 M
39.16	0.58	1.437 M
38.63	1.79	1.450 M
38.46	2.20	1.453 M;B
37.23	2.24	1.436 B
31.49	2.54	1.368 B
24.24	3.08	1.277 B
17.89	3.42	1.204 B
11.41	4.16	1.143 B
5.57	5.67	1.099 B
0.0	8.49	1.074 B

$Na_2MoO_4 + NaIO_3 + H_2O$

Gms. per 100 gms. Sat. Sol.		Density
Na_2MoO_4	$NaIO_3$	
39.38	0.0	1.432 M
38.30	1.80	1.442 M
37.09	3.86	1.453 M
35.58	6.30	1.468 M,I
32.64	7.49	1.440 I
27.53	9.86	1.398 I
22.44	12.56	1.363 I
16.18	16.35	1.326 I
11.47	19.40	1.304 I
4.85	24.42	1.278 I
0.0	28.29	1.264 I

Data of Ricci and Linke, 1947 (Con.)

$Na_2MoO_4 + NaClO_3 + H_2O$

Gms. per 100 gms. Sat. Sol.		Density	Gms. per 100 gms. Sat. Sol.		Density
Na_2MoO_4	$NaClO_3$		Na_2MoO_4	$NaClO_3$	
39.38	0.0	1.432 M	13.04	37.05	1.472 M
36.11	4.23	1.441 M	11.77	39.21	1.479 M,C
32.42	9.04	1.441 M	11.74	39.29	1.476 C
29.53	14.12	1.440 M	8.87	41.85	1.465 C
22.83	21.94	1.442 M	5.72	44.70	1.456 C
17.85	29.14	1.453 M	2.60	47.60	1.438 C
14.59	34.39	1.466 M	0.0	50.02	1.433 C

MoO M = $Na_2MoO_4 \cdot 2H_2O$ B = $NaBrO_3$ C = $NaClO_3$ I = $NaIO_3 \cdot H_2O$

EQUILIBRIUM IN THE SYSTEM SODIUM MOLYBDATE - SODIUM NITRATE - WATER AT 25°

(Ricci and Doppelt, 1944)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
Na_2MoO_4	$NaNO_3$			Na_2MoO_4	$NaNO_3$		
39.42	0.0	1.430	$Na_2MoO_4 \cdot 2H_2O$	14.42	35.36	1.453	$Na_2MoO_4 \cdot 2H_2O + NaNO_3$
33.28	8.09	-	"	14.28	35.46	1.455	$NaNO_3$
30.34	11.95	-	"	10.74	38.46	1.434	"
25.93	18.07	-	"	5.03	43.44	1.405	"
21.20	24.82	-	"	0.0	47.87	1.389	"
15.16	34.23	1.446	"				

EQUILIBRIUM IN THE SYSTEM SODIUM MOLYBDATE - SODIUM SULFATE - WATER AT 25°

(Ricci and Linke, 1951)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
Na_2MoO_4	Na_2SO_4			Na_2MoO_4	Na_2SO_4		
0.0	21.55	1.201	S	29.50	10.57	1.426	S^e
6.16	18.50	1.238	S	30.33	10.75	1.446	$M + S^{e+}$
12.40	15.53	1.273	S	30.45	10.57	1.444	M
19.31	13.11	1.328	S	32.37	8.23	1.441	M
23.34	12.28	1.360	S^a	34.19	6.09	1.435	M
25.32	11.57	1.375	S^b	39.38	0.0	1.432	M
26.19	11.29	1.380	S^c				
28.31	10.89	1.415	S^d				

S = $Na_2SO_4 \cdot 10H_2O$
M = $Na_2MoO_4 \cdot 2H_2O$

S^a = $Na_2SO_4 \cdot 10H_2O$ + 1.7% Na_2MoO_4
S^b = " + 2.3% "
S^c = " + 2.2% "
S^d = " + 2.5% "
S^e = " + 2.5% "

SODIUM PERMANGANATE $NaMnO_4$ MnO

A 25% solution of sodium permanganate freezes at -9° and a 41% solution of sodium permanganate freezes at -15°. (Bellinger, Friedman, et al, 1946).

SODIUM NITRITE $NaNO_2$ NO

At 25°, 16.78 gms. sodium nitrite dissolve in 100 gms. of ethylene glycol.

At 25°, 8.47 gms. sodium nitrite dissolve in 100 gms. of propylene glycol. (Palit, 1947)

SODIUM NITRATE $NaNO_3$ NO

SOLUBILITY OF SODIUM NITRATE IN AMMONIA SOLUTIONS AT 0°

(Achoumov, 1939)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
NH_3	$NaNO_3$	NH_3	$NaNO_3$	NH_3	$NaNO_3$
0.0	42.2	25.8	34.0	42.0	45.1
4.28	37.5	26.9	34.3	42.5	48.2
11.0	31.8	27.8	37.2	42.7	50.9
14.8	31.0	30.7	34.6	43.5	50.4
23.1	30.7	33.1	37.6	44.7	51.9
22.7	31.0	35.1	39.2	44.4	55.6
24.4	32.0	40.8	45.2		

EQUILIBRIUM IN THE SYSTEM SODIUM NITRATE - SODIUM DIHYDROGEN PHOSPHATE - WATER

(Shpunt, 1941)

The eutectic temperature is -19.4° and the saturated solution contains 30.8% $NaNO_3$ and 7.4% NaH_2PO_4.

Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaNO_3$	NaH_2PO_4	
Results at -17.5°		
38.4	0.0	$NaNO_3$ + Ice
34.4	3.6	$NaNO_3$
32.2	6.3	"
31.0	7.6	$NaNO_3 + NaH_2PO_4 \cdot 2H_2O$
30.0	8.0	$NaH_2PO_4 \cdot 2H_2O$
27.5	9.4	"
25.2	10.7	$NaH_2PO_4 \cdot 2H_2O$ + Ice
26.3	8.9	Ice
28.3	7.4	"
30.0	5.9	"
32.8	3.4	"
Results at -14°		
39.1	0.0	$NaNO_3$
35.3	3.7	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaNO_3$	NaH_2PO_4	
Results at -14° (Con.)		
33.0	6.4	$NaNO_3$
31.4	8.2	$NaNO_3 + NaH_2PO_4 \cdot 2H_2O$
31.2	8.3	$NaH_2PO_4 \cdot 2H_2O$
28.2	9.6	"
25.0	12.0	"
16.2	17.8	"
14.0	19.4	$NaH_2PO_4 \cdot 2H_2O$ + Ice
15.5	17.1	Ice
21.2	10.0	"
22.5	7.6	"
24.4	6.4	"
25.8	5.1	"
28.2	2.9	"
31.4	0.0	"

Data of Shpunt, 1941 (Con.)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$NaNO_3$	NaH_2PO_4		$NaNO_3$	NaH_2PO_4	
		Results at -9.9°			
39.8	0.0	$NaNO_3$	9.8	28.6	$NaH_2PO_4 \cdot 2H_2O$
38.99	1.30	"	9.1	24.1	"
36.2	3.8	"	4.3	28.4	"
34.95	6.01	"	0.0	32.4	NaH_2PO_4 + Ice
33.7	6.6	"	4.5	25.0	Ice
32.13	8.5	"	8.0	19.2	"
32.37	9.02	$NaNO_3 + NaH_2PO_4 \cdot 2H_2O$	10.0	17.3	"
32.0	8.8	$NaH_2PO_4 \cdot 2H_2O$	12.1	13.3	"
29.3	10.0	"	16.6	7.9	"
29.85	10.43	"	17.7	6.0	"
25.8	12.3	"	19.0	5.0	"
21.3	15.75	"	20.2	3.9	"
16.6	18.1	"	21.8	2.3	"
13.38	20.74	"	23.3	0.0	"
		Results at 0°			
41.9	0.0	$NaNO_3$	28.81	13.17	$NaH_2PO_4 \cdot 2H_2O$
38.67	4.02	"	27.8	13.2	"
38.43	4.0	"	19.97	19.50	"
35.8	7.0	"	18.2	20.0	"
35.24	7.98	"	10.8	25.9	"
34.2	9.0	"	10.52	26.67	"
32.96	10.64	$NaNO_3 + NaH_2PO_4 \cdot 2H_2O$	4.70	31.83	"
32.7	10.5	"	4.0	32.6	"
32.0	10.9	$NaH_2PO_4 \cdot 2H_2O$	0.0	36.4	"
		Results at 10°			
43.9	0.0	$NaNO_3$	30.3	14.4	$NaH_2PO_4 \cdot 2H_2O$
40.5	4.2	"	21.3	20.4	"
37.7	7.4	"	19.9	21.9	"
36.1	9.5	"	12.1	29.0	"
34.1	11.6	"	8.0	33.0	"
32.7	13.6	$NaNO_3 + NaH_2PO_4 \cdot 2H_2O$	3.8	36.8	"
			0.0	40.5	
		Results at 20°			
46.0	0.0	$NaNO_3$	31.5	18.1	$NaH_2PO_4 \cdot 2H_2O + NaNO_3$
42.7	4.6	"	24.0	23.0	$NaH_2PO_4 \cdot 2H_2O$
39.8	7.8	"	22.5	24.7	"
38.89	8.86	"	20.44	26.10	"
38.0	9.9	"	13.6	32.6	"
36.1	12.4	"	13.33	32.27	"
33.35	15.57	"	7.5	38.1	"
33.1	15.8	"	3.4	42.2	"
32.05	17.79	$NaH_2PO_4 \cdot 2H_2O + NaNO_3$	0.0	45.3	

NO

Data of Shpunt, 1941 (Con.)

Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. NaH_2PO_4	Solid Phase	Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. NaH_2PO_4	Solid Phase
		Results at 30°			
48.0	0.0	$NaNO_3$	26.89	26.72	$NaNO_3 + NaH_2PO_4 \cdot 2H_2O$
44.8	4.7	"	27.2	26.0	"
43.98	6.25	"	25.2	27.6	$NaH_2PO_4 \cdot 2H_2O$
41.9	8.1	"	24.33	28.85	"
41.31	9.10	"	15.4	36.5	"
39.8	10.4	"	14.95	37.45	"
38.0	13.0	"	11.41	40.76	"
37.77	13.31	"	6.6	45.0	"
34.8	16.7	"	6.25	46.20	"
32.25	20.3	"	3.04	48.87	"
28.10	24.99	"	3.0	49.1	"
			0.0	51.2	"

EQUILIBRIUM IN THE SYSTEM SODIUM NITRATE - SODIUM SULFATE - WATER AT 240°

(Benrath, 1948)

The transition α-$Na_2SO_4 \rightleftharpoons \beta$-$Na_2SO_4$ was found to occur at 240° and the addition of $NaNO_3$ did not change the transition temperature.

Gms. per 100 gms. Sat. Sol. Na_2SO_4	Gms. per 100 gms. Sat. Sol. $NaNO_3$	Solid Phase
21.6	18.4	α-$Na_2SO_4 + \beta$-Na_2SO_4
16.1	35.9	"
11.3	51.7	"
4.9	75.1	"
4.3	81.7	"

1.5 gms. $NaNO_3$ dissolve in 100 gms. of anhydrous HNO_3 (Temperature not given). -Jander and Wendt, 1948.

The density, viscosity, reochor, specific conductivity, surface tension, parachor, freezing point depression, magnetic susceptibility transport numbers, and E.M.F. were measured in the system $NaNO_3$-$Pb(NO_3)$-H_2O by Nayar and Pande, 1948.

EQUILIBRIUM IN THE SYSTEM SODIUM NITRATE - DIOXANE - WATER AT 25°
(Selikson and Ricci, 1942)

NO

Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. H_2O	Density	Solid Phase	Gms. per 100 gms. Sat. Sol. $NaNO_3$	Gms. per 100 gms. Sat. Sol. H_2O	Density	Solid Phase
47.87	52.13	1.384	N	12.17	27.99	1.108	O(L)
40.91	48.22	1.321	N	0.74	7.88	1.033	O(U)
34.94	44.85	1.266	N	2.34	14.47	-	O(U)
32.35	43.27	1.252	N	0.24	4.63	1.029	N
24.69	36.60	1.191	N	.12	3.86	1.028	N
20.02	31.88	1.157	N	.05	2.00	1.029	N
a) 17.84	30.03	1.146	N(L)	.072	3.74	-	N
b) 0.44	6.16	1.032	N(U)	.032	2.86	-	N
15.36	29.20	-	O(L)	.009	1.90	-	N
14.71	28.70	1.129	O(L)	.005	0.96	-	N
0.57	7.08	1.035	O(U)	.003	0.0	-	N

a,b = Invariant points N = $NaNO_3$ L = Lower Layer
U = Upper Layer O = No Solid Phase

33.5 gms. $NaNO_3$ dissolve in 100 gms. ethylene diamine at 25°. (Isbin and Kobe, 1945).

The effect of the addition of 0.06 - 0.12 molar sodium nitrate on the mutual solubility of n-butyl alcohol and water is reported by Reber, McNabb, and Lucasse, 1942.

Melting points in the system $NaNO_3$ - $RbNO_3$ are given by Bliden (1941), and for $NaNO_3$ - Guanidine Nitrate by Clark and Esterbrook, 1949.

O SODIUM OXIDE Na_2O

The reactions between Na_2O and TiO_2 in the molten state were studied by Lux, 1949.

OH SODIUM HYDROXIDE NaOH

Correction to Volume I : p. 1286 (First table)

Title should read "Equilibrium in the system Potassium Hydroxide, Acetone and Water at 0°." (Gibby, 1934).

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE - AMMONIA - WATER
(Ayres, 1945)

t°	Upper Layer Wt.% NH_3	Upper Layer Wt.% NaOH	Lower Layer Wt.% NH_3	Lower Layer Wt.% NaOH	Pressure lbs. per Sq. in.	Phases Present
60	79.1	1.4	7.8	51.0	318	Vapor + Two Liquids + $NaOH \cdot H_2O$
	77.5	1.7	8.0	50.0	310	Vapor + Two Liquids
	73.3	2.3	9.5	47.7	298	"
	67.0	4.3	12.3	42.9	290	"
	61.8	6.8	15.0	39.4	275	"
	54.0	10.7	19.8	35.2	265	"
	46.9	14.4	24.2	30.9	263	"
	43.4	17.1	26.2	29.2	261	"

Data of Ayres, 1945 (Con.)

t°	Upper Layer Wt.% NH_3	Upper Layer Wt.% NaOH	Lower Layer Wt.% NH_3	Lower Layer Wt.% NaOH	Pressure Lbs. per Sq. in.	Phases Present
60	40.5	18.9	28.2	27.6	262	Vapor + Two Liquids
	40.9	18.6	28.7	27.5	262	"
	(One Liquid Phase)		93.1	0.4	367	Vapor + Liquid + $NaOH \cdot H_2O$
	(")		96.7	0.0	373	Vapor + Liquid + NaOH + $NaOH \cdot H_2O$
50	70.0	3.4	11.4	44.8	235	Vapor + Two Liquids + $NaOH \cdot H_2O$
	67.2	4.5	12.3	42.9	233	Vapor + Two Liquids
	59.4	7.5	15.8	38.7	220	"
	54.1	10.2	19.2	35.5	212	"
	45.4	15.6	24.8	30.2	207	"
	41.9	18.0	29.2	27.3	205	"
	(One Liquid Phase)		96.4	0.0	301	Vapor + Liquid + $NaOH \cdot H_2O$ + NaOH
	(")		90.1	0.0	277	Vapor + Liquid + $NaOH \cdot H_2O$
40	59.4	7.9	15.9	38.4	165	Vapor + Two Liquids + $NaOH \cdot H_2O$
	56.6	9.5	18.6	35.4	166	Vapor + Two Liquids
	49.2	13.0	21.8	32.6	155	"
	40.8	19.1	28.5	27.2	153	"
35	50.9	13.0	20.7	35.3	138	Vapor + Two Liquids + $NaOH \cdot H_2O$
25	(One Liquid Phase)		60.5	6.6	-	$NaOH \cdot H_2O$
	(")		56.7	8.3	-	"
	(")		45.1	15.0	-	"
	(")		24.5	29.1	-	"
	(")		3.9	48.4		"

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE - HYDRAZINE - WATER

(Penneman and Audrieth, 1949)

t°	Lower Liquid (L_1) Wt. % N_2H_4	Lower Liquid (L_1) Wt. % NaOH	Upper Liquid (L_2) Wt.% N_2H_4	Upper Liquid (L_2) Wt.% NaOH	Phases Present
100	5.7	70.3	92.7	2.4	$L_1 + L_2$ + NaOH
	9.2	62.9	87.5	3.0	$L_1 + L_2$
	15.5	54.4	80.6	6.4	"
	23.2	46.1	70.6	11.6	"
	32.9	37.8	59.0	19.1	"
	45.9	27.9	45.9	27.9	Plait Point
90	-	-	98.1	0.1	L + NaOH
	-	-	93.0	1.2	"
	5.9	69.3	92.2	2.0	$L_1 + L_2$ + NaOH
	6.4	68.4	91.6	2.1	$L_1 + L_2$
	7.8	65.2	89.5	2.6	"
	9.3	62.8	87.7	3.4	"
	19.9	49.8	75.1	9.2	"
	21.9	47.8	72.6	10.8	"
	25.3	44.9	68.9	12.6	"
	35.0	36.9	57.0	20.8	"
	45.6	28.2	45.6	28.2	Plait Point
70	6.7	67.6	90.9	3.2	$L_1 + L_2$ + NaOH
	7.8	65.2	90.0	2.4	$L_1 + L_2$
	9.0	63.0	87.9	3.6	"
	17.5	52.0	78.0	8.0	"
	23.6	45.8	70.5	12.2	"
	33.6	37.5	57.7	20.1	"
	45.4	28.5	45.4	28.5	Plait Point

Data of Penneman and Audrieth, 1949 (Con.)

t°	Lower Liquid (L_1) Wt.%		Upper Liquid (L_2) Wt.%		Phases Present
	N_2H_4	NaOH	N_2H_4	NaOH	
60	–	–	92.6	1.8	L + NaOH
	–	–	91.5	2.2	L + NaOH + $NaOH \cdot H_2O$
	–	–	90.0	3.0	L + $NaOH \cdot H_2O$
	–	–	79.6	7.8	L + $NaOH \cdot H_2O$
	19.0	51.2	77.4	8.9	L_1 + L_2 + $NaOH \cdot H_2O$
	22.9	47.4	71.7	12.3	L_1 + L_2
	36.7	36.3	55.8	22.7	"
	45.5	29.6	45.5	29.6	Plait Point
50	–	–	94.0	1.5	L + $NaOH \cdot H_2O$
	–	–	93.1	1.7	"
	–	–	87.8	3.7	"
	–	–	83.1	7.4	"
	–	–	60.0	17.2	"
	–	–	45.9	26.2	"
	–	–	39.3	29.4	"
	–	–	23.1	40.4	"

O H

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE - ACETONE - WATER AT 0°

(Gibby, 1934)

See correction to volume I given on page 476.

Points on the binodal curve were determined by titration of acetone into aqueous sodium hydroxide solutions until a permanent separation into two layers was observed. A few mixtures of known composition were prepared in which the amount of NaOH in each layer was determined.

Points on the binodal curve — Gms. per 100 gms. Sat. Sol.

C_3H_6O	NaOH	C_3H_6O	NaOH	C_3H_6O	NaOH	C_3H_6O	NaOH
1.1	27.2	9.8	13.1	18.3	8.0	29.2	5.3
1.4	25.7	9.6	12.2	22.0	7.9	34.0	4.5
2.3	24.3	15.2	9.4	24.0	7.0	34.8	4.3
4.9	19.6	16.1	9.2	25.2	6.9	43.7	2.6
6.4	17.2	16.3	9.1	24.8	6.7	57.4	1.1
9.9	13.3	17.3	8.4	27.1	6.4	62.9	0.7
				26.7	5.9	73.3	0.3

·Synthetic mixtures·

Original		Wt.% NaOH found in	
C_3H_6O	NaOH	Aqueous layer	Acetone layer
42.0	7.1	12.74	0.5
58.3	7.5	19.4	0.1
61.5	8.5	21.1	0.06
41.6	9.8	16.7	0.1

EQUILIBRIUM IN THE SYSTEM SODIUM HYDROXIDE - ETHANOL - WATER

(Peyronel, 1949a) OH

t°	Upper Layer Gms. per 100 gms. Sat. Sol.		Lower Layer Gms. per 100 gms. Sat. Sol.	
	C_2H_5OH	NaOH	C_2H_5OH	NaOH
17	52.20	23.28	0.84	39.54
	48.45	18.30	2.77	31.35
	33.50	18.66	7.35	26.70
	23.90	21.90	(one layer)	
30	56.13	24.07	0.76	42.20
	56.08	22.95	0.74	42.65
	52.80	16.63	2.34	32.04
	42.80	16.30	8.17	24.73
	23.90	19.56	(one layer)	
60	64.20	22.38	-	44.45
	65.18	13.69	1.79	34.82
	62.50	9.50	5.22	26.44
	54.10	10.21	9.95	23.32
90	71.20	18.99	-	47.45
	70.50	13.06	-	35.47
	71.40	9.90	2.61	31.70
	51.38	10.50	9.50	23.50

SODIUM META PHOSPHATE $NaPO_3$ PO

Melting points in the system $NaPO_3$ + $Na_4P_2O_7$ have been determined by Partridge, Hicks, and Smith (1941) and by Morey and Ingerson (1944).

SODIUM DIHYDROGEN HYPOPHOSPHITE NaH_2PO_2 PO

At 25°, 33.01 gms. NaH_2PO_2 dissolve in 100 gms. of ethylene glycol.

At 25°, 9.70 gms. NaH_2PO_2 dissolve in 100 gms. of propylene glycol.
(Palit, 1947)

TRISODIUM PHOSPHATE Na_3PO_4 PO

SOLUBILITY OF TRISODIUM PHOSPHATE IN WATER

(Kobe and Leipper, 1940)

The authors review the work of previous investigators and point out that a basic salt, approximately $Na_3PO_4 \cdot 1/5NaOH$ ($12H_2O$), crystallizes from solutions containing $3Na_2O:P_2O_5$. The present determinations agree fairly well with those of Apfel (Vol.I, p.1287) but differ considerably from those of Mulder (I.C.T.), who found a higher value at each temperature. Kobe and Leipper used a product of analytical composition $Na_3PO_4 \cdot 1/7NaOH \cdot 12H_2O$, but did not determine the composition of the saturating phase after equilibrium was established. The results were calculated in terms of the theoretical Na_3PO_4.

Data of Kobe and Leipper, 1940

t°	Gms. Na_3PO_4 per 100 gms. Sat. Sol.	t°	Gms. Na_3PO_4 per 100 gms. Sat. Sol.
0	4.43	60	40.3
20	11.45 (a)	80	61.5
25	11.48	100	86.8
25	15.48 (b)	105	98.9 (b)
40	20.0		

(a) Teeple, 1929 (b) Oboukhov and Mikhailova, 1935

Several points in the system $Na_2O - P_2O_5 - H_2O$ at 25° were also determined, and the results disagree with those of D'Ans and Schreiner (Vol. I, p. 1290).

PO EQUILIBRIUM IN THE SYSTEM TRISODIUM PHOSPHATE - SODIUM CARBONATE - WATER

(Kobe and Leipper, 1940)

Gms. per 100 gms. H_2O		Solid Phase	Gms. per 100 gms. H_2O		Solid Phase
$Na_3PO_4 \cdot 1/7NaOH$	Na_2CO_3		$Na_3PO_4 \cdot 1/7NaOH$	Na_2CO_3	
Results at -2.48°			Results at 40°		
1.8	5.5	T.S.P. + $Na_2CO_3 \cdot 10H_2O$	20.8	0.0	T.S.P.
			15.1	15.1	"
Results at -2.10°			11.6	35.0	"
			11.1	43.1	T.S.P. + $Na_2CO_3 \cdot H_2O$
0.0	6.1	$Na_2CO_3 \cdot 10H_2O$	0.0	49.2	$Na_2CO_3 \cdot H_2O$
Results at -1.21°			Results at 60°		
4.2	0.0	T.S.P.	41.8	0.0	T.S.P.
			36.6	11.1	"
Results at 0°			31.0	23.5	"
			28.0	31.2	T.S.P. + $Na_2CO_3 \cdot H_2O$
4.58	0.0	T.S.P.	11.4	40.0	$Na_2CO_3 \cdot H_2O$
2.58	6.43	T.S.P. + $Na_2CO_3 \cdot 10H_2O$	0.0	46.3	"
0.0	6.93	$Na_2CO_3 \cdot 10H_2O$	63.8	0.0	T.S.P.
			52.3	20.0	T.S.P. + $Na_2CO_3 \cdot H_2O$
Results at 25°			0.0	45.1	$Na_2CO_3 \cdot H_2O$
			90.0	0.0	T.S.P.
11.9	0.0	T.S.P.	88.0	10.9	T.S.P. + $Na_2CO_3 \cdot H_2O$
10.7	3.60	"	67.1	17.4	$Na_2CO_3 \cdot H_2O$
9.30	6.96	"	62.1	18.7	"
8.05	13.0	"	39.0	27.7	"
7.01	19.4	"	23.0	35.2	"
5.79	28.0	T.S.P. + $Na_2CO_3 \cdot 10H_2O$	0.0	44.8	"
3.44	28.5	$Na_2CO_3 \cdot 10H_2O$			
0.0	29.4	"			

T.S.P. = Trisodium Phosphate

PO

SODIUM DIHYDROGEN PHOSPHATE NaH_2PO_4

SOLUBILITY OF SODIUM DIHYDROGEN PHOSPHATE IN WATER

(Shpunt, 1941)

The results agree with those of previous workers (Vol. I, p. 1289-90).

t°	Gms. NaH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. NaH_2PO_4 per 100 gms. Sat. Sol.	Solid Phase
-2.0	7.0	Ice	1.8	37.1	$NaH_2PO_4 \cdot 2H_2O$
-2.7	10.0	"	4.4	38.1	"
-3.5	12.8	"	9.9	40.6	"
-4.9	17.8	"	15.6	43.2	"
-6.3	22.0	"	19.6	45.2	"
-7.5	25.6	"	23.4	47.3	"
-8.7	28.8	"	25.7	48.7	"
-9.9	32.4	Ice + $NaH_2PO_4 \cdot 2H_2O$	28.6	50.1	"

PO

TRISODIUM HYDROGEN PYROPHOSPHATE $Na_3HP_2O_7$

SOLUBILITY IN WATER

(Hubbard, 1949)

The salt was prepared by adding NaOH to a suspension of $Na_2H_2P_2O_7$ in water, and subsequent recrystallization. Solutions of the salt slowly hydrolyzed and the results are listed for solutions which stood between 24 and 48 hours, which corresponds to about 0.1% orthophosphate produced in the solution.

t°	Gms. $Na_3HP_2O_7$ per 100 gms. Sat. Sol.	Solid	t°	Gms. $Na_3HP_2O_7$ per 100 gms. Sat. Sol.	Solid
20.7	14.15	9	32.9	27.50	9
21.0	14.28	9	36.1	32.70	9
26.5	20.00	9	32.9	22.15	1
27.3	20.25	9	36.1	21.55	1
27.3	20.30	9	42.2	20.30	1
29.0	22.62	9	48.0	19.20	1
32.2	26.50	9	49.5	18.90	1

9 = $Na_3HP_2O_7 \cdot 9H_2O$ 1 = $Na_3HP_2O_7 \cdot H_2O$

PO

SODIUM PHOSPHATE (Poly) $(Na_5P_3O_{10})_x$

The solubility of the polymer $(Na_5P_3O_{10})_x$ where x is 2 or more, is 32.5 gms. per 100 gms. saturated solution at 25°. This is more than twice as soluble as the monomer. (King, 1947).

ReO

SODIUM PERRHENATE $NaReO_4$

SOLUBILITY IN WATER

(Smith and Long, 1948)

Temperature°:	0	30	50.3
Gms. $NaReO_4$ per 100 gms. H_2O:	103.3	145.3	173.8

S SODIUM SULFIDE Na_2S

SOLUBILITY OF SODIUM SULFIDE IN WATER
(Konopik and Schutz, 1949)

The densities of unsaturated solutions were also determined. These results do not agree well with those of previous workers (Vol. I, p. 1294, 1295), whose results are also in poor agreement with each other.

	20°	30°	40°
Gms. Na_2S per 100 gms. Sat. Sol. :	16.57	19.80	23.25
Density d_4^t	1.1682	1.1972	1.2287

The system $Na_2S - H_2S - H_2O$ was studied at 25°, 50°, and 100° by Sagaidachnyi, Vasilev, and Roskina, 1939.

SO SODIUM SULFITE Na_2SO_3

SOLUBILITY OF SODIUM SULFITE IN AMMONIUM SULFITE SOLUTIONS
(Silberman and Ivanov, 1941)

Results at 60°			Results at 85°		
Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2SO_3	$(NH_4)_2SO_3$		Na_2SO_3	$(NH_4)_2SO_3$	
12.20	38.11	Na_2SO_3	5.52	47.16	Na_2SO_3
11.06	41.94	"	5.25	49.40	"
8.35	45.08	$Na_2SO_4+(NH_4)_2SO_3 \cdot H_2O$	5.51	54.67	$Na_2SO_3+(NH_4)_2SO_3$

SO SODIUM SULFATE Na_2SO_4

Correction to Volume I, p. 1256, last two lines:

omit the words "...both anhydrous sodium sulfate and..."

The author's name is spelled Takeuchi.

SOLUBILITY OF SODIUM SULFATE IN WATER AND DEUTERIUM OXIDE
(Eddy and Menzies, 1940)

[See NOTE page 67.]

Results in H_2O

t°	Gms. Na_2SO_4 per 100 gms. H_2O	Solid Phase	t°	Gms. Na_2SO_4 per 100 gms. H_2O	Solid Phase
0	17.8	$Na_2SO_4 \cdot 7H_2O$ (m)	15	37.2	$Na_2SO_4 \cdot 7H_2O$ (m)
5	23.3	"	20	45.2	"
10	29.9	"	23.7	52.4	"+Na_2SO_4

Data of Eddy and Menzies, 1940 (Con.)

Results in D_2O

t°	Gms. Na_2SO_4 per 100 gms. D_2O	Solid Phase	t°	Gms. Na_2SO_4 per 100 gms. D_2O	Solid Phase
0	12.7	$Na_2SO_4 \cdot 7D_2O$ (m)	25	21.1	$Na_2SO_4 \cdot 10D_2O$
5	17.4	" (m)	30	30.9	"
10	22.6	" (m)	34.2	44.0	$Na_2SO_4 \cdot 10D_2O + Na_2SO_4$
15	28.6	" (m)	25	46.7	Na_2SO_4 (m)
20	35.2	" (m)	40	42.9	A
25	42.9	" (m)	60	39.8	A
26.7	46.0	$Na_2SO_4 \cdot 7D_2O$ (m) + Na_2SO_4	80	38.0	A
0	3.41	$Na_2SO_4 \cdot 10D_2O$	100	37.3	A
5	4.47	"	120	37.0	A
10	6.53	"	140	37.3	A
15	9.83	"	160	37.4	A
20	14.3	"	180	37.7	A

(m) = Metastable

SOLUBILITY OF SODIUM SULFATE IN WATER ABOVE 100°

(Benrath, 1941)

t°	Gms. Na_2SO_4 per 100 gms. Sat. Sol.	t°	Gms. Na_2SO_4 per 100 gms. Sat. Sol.
262	28.2	299	15
275	25	308	10
289	20	319	5

SOLUBILITY OF SODIUM SULFATE IN SODIUM HYDROXIDE SOLUTIONS AT 50°

(Imkana, 1949)

Gms. Na_2SO_4 per 100 gms. Sat. Sol.	15.98	5.95	0.55
Gms. NaOH per 100 gms. Sat. Sol.	8.73	18.65	34.34

SOLUBILITY OF SODIUM SULFATE IN SODIUM HYDROXIDE SOLUTIONS AT 100°

(Green and Frattali, 1946)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
Na_2SO_4	NaOH	Na_2SO_4	NaOH	Na_2SO_4	NaOH
30.0	0.0	9.5	15.4	2.9	27.4
22.9	4.0	6.8	18.4	2.1	31.6
16.2	8.6	4.7	22.9	1.7	35.2
12.7	12.1				

SOLUBILITY OF SODIUM SULFATE IN AQUEOUS AMMONIA SOLUTIONS

(Guyer, Bieler and Orelli, 1940)

The data were read from curves drawn by the authors. The results are in gms. Na_2SO_4 per 100 gms. solvent.

t°	% NH_3 in solvent				
	10	20	40	60	80
-30	-	1.4	0.8	0.8	0.7
-10	1.2	0.8	0.6	0.6	0.5
0	1.9	1.2	1.1	1.1	0.7
23	10	3.0	1.3	1.3	0.9

The solubility of sodium sulfate in aqueous ammonia solutions was determined by Belopolskii and Aleksandorv at 5°, 15°, and 25° (1931), at 0° (1932) and the data at all four temperatures is given in (1943).

SO

SOLUBILITY OF SODIUM SULFATE IN AMMONIUM CARBONATE SOLUTIONS AT 32.5°

(Belopolski and Urussov, 1935)

Gms. per 100 gms. Sat. Sol.			Solid Phase	Gms. per 100 gms. Sat. Sol.			Solid Phase
Na_2SO_4	$(NH_4)_2CO_3$	$(NH_4)_2SO_4$		Na_2SO_4	$(NH_4)_2CO_3$	$(NH_4)_2SO_4$	
33.62	0.0	-	S	25.90	14.80	-	S
32.64	1.81	-	S	24.57	18.54	-	S
31.70	3.52	-	S	24.16	19.21	0.10	S,C
30.53	5.19	-	S	23.26	19.94	1.13	C
29.80	7.15	-	S	22.60	21.25	1.03	C
28.00	10.44	-	S	21.41	23.80	1.45	C

S = Na_2SO_4 C = $NaHCO_3$

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - SULFUR TRIOXIDE - VANADIUM PENTOXIDE - WATER AT 25°

(Makarov and Repa, 1940)

Gms. per 100 gms. Sat. Sol.			Solid Phase	Gms. per 100 gms. Sat. Sol.			Solid Phase
Na_2O	V_2O_5	SO_3		Na_2O	V_2O_5	SO_3	
17.04	3.35	5.95	F	7.40	2.00	11.44	M
12.66	3.02	11.50	G	8.87	2.93	9.65	M
12.89	4.34	10.00	G	13.88	13.75	10.00	M
11.41	2.42	7.20	G + M	9.21	3.38	14.96	M + G
14.51	5.80	10.20	G + M + F	9.81	3.58	15.01	G + T + E
10.40	1.03	5.04	M + F	6.75	2.15	11.20	M + S
15.19	5.09	7.62	M + F	14.25	17.00	6.60	M
14.00	1.16	2.80	M + F + N	18.30	21.80	6.72	M
12.60	7.43	9.30	M + N	4.02	11.12	0.80	M + K + S
15.15	14.01	7.90	M + N	2.76	8.46	58.00	S + I + E
14.93	17.04	6.44	M + N	0.02	4.42	55.00	S + I
9.44	3.41	11.25	M + G	2.19	4.01	53.40	E + I
8.16	1.31	9.83	M + G	2.87	8.78	50.00	S + P + E
9.24	3.57	10.84	M	2.78	2.20	34.20	P + Q + E

Data of Makarov and Repa, 1940 (Con.)

Gms. per 100 gms. Sat. Sol.			Solid Phase	Gms. per 100 gms. Sat. Sol.			Solid Phase
Na_2O	V_2O_5	SO_3		Na_2O	V_2O_5	SO_3	
2.50	1.41	25.36	Q + T + E	1.25	1.31	3.27	T
8.20	3.92	19.74	E	18.41	7.62	6.40	N
12.61	8.18	20.46	T + E + Q	16.17	1.30	Trace	F + C
7.36	4.20	17.48	T + E	14.12	16.15	5.25	N + M
6.98	3.00	20.05	"	12.46	0.85	1.70	"
10.71	21.90	3.50	C	15.60	4.63	3.73	N + F + C
9.68	18.40	3.02	C	14.60	1.90	0.19	C + F
10.55	15.43	3.92	C + M	19.98	1.42	Trace	"
4.62	11.38	0.24	C + S	26.50	1.85	"	C + F + D
4.66	11.15	0.40	"	10.00	6.42	2.60	N + C
2.80	5.35	1.00	M + S	11.98	11.20	3.60	"
8.89	11.95	6.56	"	18.70	13.75	3.50	"
2.49	2.42	3.55	T	9.54	17.00	1.23	M + K

$S = V_2O_5$
$T = V_2O_5 \cdot 3H_2O$
$K = Na_2V_6O_{16} \cdot 29H_2O$
$E = NaHSO_4$
$C = Na_8V_2O_9 \cdot 30H_2O$
$P = V_2O_5 \cdot H_2O$
$N = Na_3VO_4 \cdot 10H_2O$
$F = Na_2SO_4$
$I = NaH_3(SO_4)_2 \cdot H_2O$
$Q = V_2O_5 \cdot 2H_2O$
$M = Na_4V_2O_7 \cdot 18H_2O$
$G = Na_2SO_4 \cdot 10H_2O$
$D = Na_2O \cdot 3H_2O$

SOLUBILITY OF SODIUM SULFATE IN ETHYLENE GLYCOL SOLUTIONS

(Vener and Thompson, 1949)

Only one liquid phase was found in the system. The results are in gms. of Na_2SO_4 per 100 gms. saturated solution, and the density is listed in each case. The authors plotted their data and read the results from the smooth curves. In the original, results are given for 5° intervals.

Solvents:

No.	Density at 25°	Gms. $C_2H_4(OH)_2$ per 100 gms. Solvent	No.	Density at 25°	Gms. $C_2H_4(OH_2$ per 100 gms. Solvent
8	1.0072	8.0	45	1.0564	45.5
12	1.0122	11.9	60	1.0739	60.6
16	1.0173	15.7	70	1.0846	69.8
25	1.0292	24.4	80	1.0935	78.8
32	1.0385	31.4	90	1.1034	90.3
40	1.0493	39.9	99	1.1096	99.2

Data of Vener and Thompson, 1949 (Con.)

t°	Solvent					
	8	12	16	25	32	40
25	19.36 1.1918	18.37 1.1858	17.46 1.1807	15.82 1.1748	13.28 1.1589	9.036 1.1289
30	27.70 1.2780	25.69 1.2604	23.02 1.2357	17.13 1.1855	13.05 1.1538	8.947 1.1256
40	27.24 1.2673	24.76 1.2447	22.19 1.2219	16.59 1.1744	12.67 1.1445	8.820 1.1189
50	26.45 1.2520	24.08 1.2311	21.56 1.2093	16.15 1.1642	12.37 1.1353	8.707 1.1119
60	25.79 1.2390	23.53 1.2185	21.06 1.1975	15.83 1.1546	12.15 1.1270	8.610 1.1049
70	25.27 1.2264	23.08 1.2066	20.64 1.1864	15.57 1.1453	12.02 1.1184	8.530 1.0966
80	24.88 1.2141	22.74 1.1955	20.32 1.1753	15.36 1.1355	11.90 1.1095	8.461 1.0877
90	24.60 1.2033	22.45 1.1847	20.09 1.1651	15.19 1.1258	11.79 1.1012	8.399 1.0798
100	24.45 1.1953	22.21 1.1759	19.91 1.1556	15.03 1.1172	11.67 1.0942	8.340 1.0724

t°	Solvent					
	45	60	70	75	90	99
25	6.924 1.1171	3.263 1.1021	1.922 1.1014	1.143 1.1035	0.773 1.1113	0.540 1.1146
30	6.865 1.1135	3.256 1.0985	1.910 1.0981	1.133 1.0999	0.734 1.1071	0.514 1.1113
40	6.770 1.1068	3.242 1.0922	1.885 1.0911	1.111 1.0927	0.668 1.0994	0.458 1.1052
50	6.708 1.1003	3.219 1.0857	1.862 1.0844	1.085 1.0856	0.608 1.0916	0.402 1.0995
60	6.670 1.0932	3.194 1.0786	1.841 1.0771	1.059 1.0785	0.550 1.0839	0.351 1.0927
70	6.637 1.0850	3.174 1.0707	1.821 1.0695	1.032 1.0718	0.508 1.0769	0.309 1.0852
80	6.606 1.0764	3.155 1.0621	1.799 1.0614	1.005 -	0.481 -	0.276 -
90	6.579 1.0686	3.139 1.0542	1.779 1.0530	0.977 -	0.457 -	0.249 -
100	6.549 1.0609	3.120 1.0464	1.4755 1.0444	0.950 -	0.438 -	0.230 -

SO

Additional Determinations Above 100°

Solvent = 10.5 Wt. % Glycol		Solvent = 41.0 Wt. % Glycol		Solvent = 67.5 Wt. % Glycol	
104.5°	B.P.	107.1°	B.P.	114.4°	B.P.
104.3°	22.91	106.7°	7.915	113.9°	1.975
103.5°	22.92	105.6°	7.910	109.8°	1.997
99.8°	22.95	100.0°	7.914	98.8°	2.034
Solvent = 18.1 Wt. % Glycol		Solvent = 45.5 Wt. % Glycol		Solvent = 75.5 Wt. % Glycol	
104.9°	B.P.	108.3°	B.P.	119.7°	B.P.
104.5°	18.46	108.0°	6.624	119.2°	1.104
102.9°	18.46	106.6°	6.611	112.7°	1.132
96.4°	18.52	100.4°	6.644	100.0°	1.190
Solvent = 24.2 Wt. % Glycol		Solvent = 48.6 Wt. % Glycol		Solvent = 80.0 Wt. % Glycol	
105.1°	B.P.	108.9°	B.P.	124.3°	B.P.
104.8°	15.19	108.8°	5.528	123.5°	0.795
103.9°	15.19	106.3°	5.530	117.3°	0.791
99.7°	15.23	98.8°	5.554	99.3°	0.860
Solvent = 36.2 Wt. % Glycol		Solvent = 60.1 Wt. % Glycol		Solvent = 90.0 Wt. % Glycol	
106.0°	B.P.	111.3°	B.P.	136.3°	B.P.
105.8°	9.839	110.9°	3.188	135.1°	0.421
104.4°	9.836	108.9°	3.183	122.7°	0.414
101.8°	9.859	100.0°	3.201	100.0°	.454

B.P. = Boiling Point

The effect of the addition of sodium sulfate (0.004 to 0.008 molar) on the mutual solubility of n-butyl alcohol and water is reported by Reber, McNabb, and Lucasse, 1942.

Melting points in the system Na_2SO_4 - $PbSO_4$ are given by Perrier, 1940.

Sodium sulfate forms a discontinuous series of solid solutions with sodium selenate at 20°. (Collet, 1949)

SODIUM HYPOSULFITE $Na_2S_2O_4$ SO

At 25° 1.34 gms. $Na_2S_2O_4$ dissolve in 100 gms. of ethylene glycol.
At 25° 0.37 gms. $Na_2S_2O_4$ dissolve in 100 gms. of propylene glycol.
(Palit, 1947)

SODIUM THIOSULFATE $Na_2S_2O_3$ SO

SOLUBILITY OF SODIUM THIOSULFATE IN WATER ABOVE 100°
(Benrath, 1942)

t°	Gms. $Na_2S_2O_3$ per 100 gms. Sat. Sol.	t°	Gms. $Na_2S_2O_3$ per 100 gms. Sat. Sol.	t°	Gms. $Na_2S_2O_3$ per 100 gms. Sat. Sol.
111	71.4	136	73.4	171	77.7
125	72.4	148	74.6	179	79.1
130	72.8	159	76.3		

Data for the conductivity and temperature coefficient of viscosity in the system $Na_2S_2O_3$-H_2O in solutions containing up to 77% $Na_2S_2O_3$ is given by Bak, 1939.

SODIUM SULFAMATE $NaSO_3NH_2$ SON

SOLUBILITY OF SODIUM SULFAMATE IN WATER
(Laning and Van der Meulen, 1947)

t°	Gms. $NaSO_3NH_2$ per 100 gms. H_2O	Solid Phase	t°	Gms. $NaSO_3NH_2$ per 100 gms. H_2O	Solid Phase
0	79.9	$NaSO_3NH_2 \cdot H_2O$	38.3	165.2	$NaSO_3NH_2 \cdot H_2O + NaSO_3NH_2$
20	113.0	"	40	168.6	$NaSO_3NH_2$
25	123.8(1)	"	45	175.1	"
25	106(2)	"	50	182.2	"
30	135.9	"	55	191.3	"
35	151.4	"			

(1) Ricci and Selikson, 1947 (2) Cupery, 1938

Melting points in the system sodium sulfamate - sodium nitrate are given by Laning and Van der Muelen, 1948.

SODIUM SILICATE Na_2SiO_3 SiO

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - SILICA - WATER

There is some agreement among the results of Harmen (Vol. I, p. 1324), Sprauer and Pearce (1940), and Lange and von Stackelberg (1948). All three investigations showed the presence of $Na_2SiO_3 \cdot 9H_2O$ and $Na_2SiO_3 \cdot 6H_2O$, but the solubilities and fields of stability of these and other compounds differ in each set of results.

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - SILICA - WATER AT 25°
(Sprauer and Pearce, 1940)

Gms. per 100 gms. Sat. Sol.		Solid Phase
Na_2O	SiO_2	
9.65	10.1	$Na_2O \cdot SiO_2 \cdot 9H_2O$
8.69	2.93	"
17.8	1.46	"
21.06	2.03	$Na_2O \cdot SiO_2 \cdot 9H_2O + Na_2O \cdot SiO_2 \cdot 6H_2O$
21.03	1.98	"
20.6	2.18	$Na_2O \cdot SiO_2 \cdot 6H_2O$
21.8	1.97	"
22.9	1.98	"
24.2	2.04	"
25.7	1.83	$Na_2O \cdot SiO_2 \cdot 6H_2O + 3Na_2O \cdot 2SiO_2 \cdot 11H_2O$
25.9	1.87	"
27.2	1.55	$3Na_2O \cdot 2SiO_2 \cdot 11H_2O$
27.8	1.23	"
28.9	0.75	"
33.0	.34	
36.7	.30	

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - SILICA - WATER

(Lange and von Stackelberg, 1948)

Gms. per 100 gms. Sat. Sol. Na_2O	Gms. per 100 gms. Sat. Sol. SiO_2	Solid Phase
	Results at 0°	
10.4	0.27	$Na_2SiO_3 \cdot 9H_2O$
13.0	.21	"
14.7	.34	"
17.9	.40	"
19.6	.48	"
21.8	.40	"
22.3	.45	"
24.8	.84	"
23.9	.74	$Na_2SiO_3 \cdot 6H_2O$
24.2	.81	"
	Results at 14°	
10.9	0.33	$Na_2SiO_3 \cdot 9H_2O$
11.8	.34	"
12.9	.56	"
19.3	.60	"
21.0	.65	"
21.5	.95	"
22.2	1.08	"
23.7	1.25	$Na_2SiO_3 \cdot 6H_2O$
25.4	1.41	"
25.8	1.14	"
26.0	1.46	"
26.3	1.18	"
26.3	1.21	"
18.9	0.94	$Na_2SiO_3 \cdot 5H_2O$
20.2	.91	"
20.9	1.08	"
26.1	1.08	"
27.4	1.17	"
25.9	1.34	$Na_6Si_2O_7 \cdot 11H_2O$
26.9	1.27	"
28.0	0.79	"
28.8	.45	"
29.7	.43	"
30.5	.29	"
30.9	.21	"
34.7	.20	"
34.8	.16	"
	Results at 25°	
12.7	1.82	$Na_2SiO_3 \cdot 9H_2O$
18.2	1.42	"
19.5	1.45	"
19.7	1.33	"
21.1	1.50	"
22.2	1.47	"
22.9	1.64	"
24.9	1.88	"
26.5	2.14	"
27.9	2.59	"
28.8	2.49	$Na_2SiO_3 \cdot 6H_2O$
30.3	2.50	"
23.3	1.59	$Na_2SiO_3 \cdot 5H_2O$
24.6	1.51	"
26.2	1.39	"
27.3	1.54	"
32.4	2.43	"
27.8	0.76	$Na_6Si_2O_7 \cdot 11H_2O$
29.2	.47	"
35.7	.47	"

Equilibrium data for the system $Na_2O - SiO_2 - H_2O$ at 250°, 300°, and 350° are presented by Tuttle and Friedman. The system posesses a liquid immiscibility gap with a lower consolute temperature between 250° and 300°.

Melting points in the system $Na_2SiO_3 - PbSiO_3 - SiO_2$ have been determined by Krakau, Mukhin, and Heinrich (1937).

VO SODIUM VANADATE

EQUILIBRIUM IN THE SYSTEM SODIUM OXIDE - VANADIUM PENTOXIDE - WATER

(Makarov and Repa, 1940)

Results at 25°

Gms. per 100 gms. Sat. Sol. Na_2O	Gms. per 100 gms. Sat. Sol. V_2O_5	Solid Phase
0.0	0.04	$V_2O_5 \cdot 3H_2O$
2.94	8.28	V_2O_5
5.56	21.87	"
5.08	22.00	"
6.58	23.06	$V_2O_5 + Na_2V_6O_{16} \cdot 20H_2O$
7.36	19.06	$Na_2V_6O_{16} \cdot 20H_2O$
8.27	20.49	"
8.94	21.33	$Na_2V_6O_{16} \cdot 20H_2O + Na_4V_2O_7 \cdot 18H_2O$
10.02	21.40	$Na_4V_2O_7 \cdot 18H_2O$
12.87	21.09	"
14.05	23.33	"
13.80	20.04	"
13.60	16.72	$Na_4V_2O_7 \cdot 18H_2O + Na_3VO_4 \cdot 10H_2O$
13.09	15.29	$Na_3VO_4 \cdot 10H_2O$
14.52	12.30	"
16.18	10.58	$Na_3VO_4 \cdot 10H_2O + Na_8V_2O_9 \cdot 30H_2O$
9.98	8.79	$Na_8V_2O_9 \cdot 30H_2O$
7.95	3.76	"
8.48	2.21	"
12.17	1.32	"
20.21	1.81	$Na_8V_2O_9 \cdot 26H_2O$
27.44	2.24	$Na_8V_2O_9 \cdot 26H_2O + Na_2O \cdot 3H_2O$
41.04	0.0	$Na_2O \cdot 3H_2O$
11.78	15.38	$Na_2VO_4 \cdot 10H_2O$
12.84	7.73	"
13.69	7.37	"
14.58	5.09	"
28.11	2.34	$Na_3VO_4 \cdot 10H_2O + Na_2O \cdot 3H_2O$
17.00	1.24	$Na_8V_2O_9 \cdot 26H_2O$

Results at 75°

Gms. per 100 gms. Sat. Sol. Na_2O	Gms. per 100 gms. Sat. Sol. V_2O_5	Solid Phase
0.0	0.09	V_2O_5
4.58	20.12	"
6.98	31.80	"
7.29	33.32	$V_2O_5 + Na_4V_2O_7$
8.82	19.50	$Na_4V_2O_7$
12.74	23.76	"
13.20	25.30	"
17.95	30.05	"
22.70	34.00	"
20.06	27.98	"
20.29	22.12	$Na_4V_2O_7 + Na_3VO_4$
18.18	22.60	Na_3VO_4
17.93	17.19	"
16.15	15.85	"
16.13	17.94	"
18.38	7.05	"
20.69	7.31	$Na_3VO_4 + Na_8V_2O_9 \cdot 12H_2O$
21.48	6.40	$Na_8V_2O_9 \cdot 12H_2O$
19.57	6.00	"
22.27	4.14	"
26.02	2.48	"
39.50	4.00	$Na_8V_2O_9 \cdot 12H_2O + Na_2O \cdot H_2O$
31.56	2.44	$Na_2O \cdot H_2O$

Cl NEODYMIUM CHLORIDE $NdCl_3 \cdot 6H_2O$

SOLUBILITY OF NEODYMIUM CHLORIDE IN WATER

(Friend and Hall, 1940)

The results agree with those of previous authors (Vol. I, p. 1330). The solid phase is $NdCl_3 \cdot 6H_2O$ throughout.

t°	Gms. $NdCl_3$ per 100 gms. Sat. Sol.	t°	Gms. $NdCl_3$ per 100 gms. Sat. Sol.	t°	Gms. $NdCl_3$ per 100 gms. Sat. Sol.
0	49.19	54.8	52.51	80.0	56.04
10	49.33	55.4	52.90	87.0	56.75
15.4	49.34	59.0	53.33	91.7	57.19
26.2	49.61	64.0	53.88	93.5	57.41
33.0	50.69	68.0	54.39	97.6	58.29
45.8	51.88	72.0	54.61	98.3	58.15

NEODYMIUM NITRATE $Nd(NO_3)_3$ NO

DISTRIBUTION OF NEODYMIUM NITRATE BETWEEN WATER AND n-HEXYL ALCOHOL AT 25°
(Templeton, 1949)

Gms. Nd_2O_3 per 100 gms. Sat. Sol.		Gms. Nd_2O_3 per 100 gms. Sat. Sol.	
Aqueous Phase	Alcohol Phase	Aqueous Phase	Alcohol Phase
30.45	5.59	25.2	1.16
29.80	5.10	23.0	0.60
29.23	4.32	22.3	.52
28.80	3.78	21.25	.35
27.7	2.64	19.8	.25
		18.2	.15

10 ml. of a saturated solution of neodymium nitrate in ether at 20° contain 267 mg. Nd_2O_3. (Wells, 1930).

The distribution coefficient of a mixture of rare earth nitrates containing 12.5% neodymium nitrate between methyl n-hexyl ketone and water at room temperature was found to be less than 0.0012, with 33.0% of anhydrous salt in the aqueous phase. (Rothchild, Templeton, and Hall, 1948).

NEODYMIUM TUNGSTATE $Nd_2(WO_4)_3$ WO

SOLUBILITY IN WATER
(Vickery, 1949)

	Unignited	Ignited
20°	0.021 gms./100 ml.	0.003 gms./100ml.
100°	.027 "	.003 "

NICKEL AMINO ACID SALTS CH

SOLUBILITY IN WATER AND METHANOL AT 24.5°
(Lang, 1939)

Amino Acid	Salt Formula	Gms. Salt per 100 gms. Sat. Sol.	
		In Water	In Methanol
Glycine	$Ni(C_2H_4O_2N)_2 \cdot 2H_2O$	2.74	0.009
d, l Alanine	$Ni(C_3H_6O_2N)_2 \cdot 2H_2O$	0.91	.020
d, l Amino Butyric	$Ni(C_4H_8O_2N)_2 \cdot 2H_2O$	2.23	.027
l (+) - Valine	$Ni(C_5H_{10}O_2N)_2$	0.39	7.90
d, l - Leucine	$Ni(C_6H_{12}O_2N)_2 \cdot 2H_2O$	0.030	0.043
d, l - Isoleucine	$Ni(C_6H_{12}O_2N)_2 \cdot 2H_2O$	0.095	3.36
l (-) - Proline	$Ni(C_5H_8O_2N)_2 \cdot 2H_2O$	19.07	15.02
d, l-Glutamic		-	0.011
d, l-Serine		-	.014
d, l-Asparaginine		-	.225

CH NICKEL p-PHENOL SULFONATE $p\text{-}Ni[C_6H_4(OH)SO_3]_2 \cdot 8H_2O$

SOLUBILITY IN WATER
(Guerreschi, 1949)

t°	Gms. $Ni[C_6H_4(OH)SO_3]_2$ per 100 gms. Sat.Sol.	t°	Gms. $Ni[C_6H_4(OH)SO_3]_2$ per 100 gms. Sat.Sol.
15.0	20.99	34.7	29.07
18.7	22.36	39.8	31.33
20.0	22.79	46.2	34.21
23.0	24.00	50.2	35.89
24.8	24.80	54.8	37.84
25.6	25.21	60.6	40.31
30.0	27.04	65.7	42.41

CO NICKEL CARBONATE $NiCO_3$

SOLUBILITY OF NICKEL CARBONATE IN WATER
(Smurov, 1938)

The total pressure of $CO_2 + H_2O$ was one atmosphere.

Partial Pressure CO_2 in atm.	Gms. Ni per 100 gms. Sat. Sol.				
	5°	15°	40°	50°	80°
0.0005	0.0168	0.0136	0.0061	0.0037	0.0007
.005	.0394	.0319	.0142	.0087	.0016
.05	.0924	.0748	.0333	.0204	.0037
.10	.1194	.0963	.0431	.0264	.0048

Cl NICKEL CHLORIDE $NiCl_2$

Data for the system $NiCl_2$ - NH_4Cl - H_2O are given by Kurnakov, Lushnar, and Kuznetsov, 1937.

SOLUBILITY OF NICKEL CHLORIDE IN ORGANIC SOLVENTS AT 25°
(Garwin and Hixson, 1949)

Solvent	Gms. $NiCl_2$ per 100 gms. Sat.Sol.	Solvent	Gms. $NiCl_2$ per 100 gms. Sat.Sol.
n - Butanol	6.1	Ethyl acetate	0.02
n - Amyl alcohol	7.25	Iso propyl acetate	.03
n - Hexanol	6.4	β - methyl butyric acid	.42
2 - Ethyl - 1 - butanol	1.49	Benzaldehyde	.13
2 - Ethyl - 1 - hexanol	0.74	Furfural	.13
Capryl - 2 - octanol:		n - Heptane	.07
a) Commercial	.16	Benzene	.03
b) Ketone free	.26	Nitromethane	.00
Methyl ethyl ketone	.01	Nitrobenzene	.02
Methyl n - propyl ketone	.01	Ethylene dichloride	.04
Methyl isobutyl ketone	.01	Chlorobenzene	.03
Aceto phenone	.05	Isopropyl ether	.00

DISTRIBUTION OF NICKEL CHLORIDE BETWEEN CAPRYL ALCOHOL AND WATER AT 25°
(Garwin and Hixson, 1949)

Aqueous phase Wt. % $NiCl_2$:	38.3	36.1	34.4	32.9	29.2
Alcohol phase Wt. % $NiCl_2$:	0.0716	0.0446	0.0302	0.0244	0.0098

Results are also given for mixtures of $NiCl_2$ + $CoCl_2$.

Cl

DISTRIBUTION OF NICKEL CHLORIDE BETWEEN CAPRYL ALCOHOL AND WATER AT 25° IN THE PRESENCE OF HYDROCHLORIC ACID
(Garwin and Hixson, 1949a)

In each experiment the aqueous phase contained 13 - 16% by wt. $NiCl_2$. Results are also given for the distributions in the presence of $CaCl_2$ and $CoCl_2$.

Wt. % Total Cl in Aqueous Phase	K_{Ni} (alc./aq.)	K_{HCl} (alc./aq.)	Wt. % Total Cl in Aqueous Phase	K_{Ni} (alc./aq.)	K_{HCl} (alc./aq.)
11.8	0.71×10^{-3}	0.220	20.7	3.24×10^{-3}	0.512
13.4	1.02 "	.309	22.3	3.51 "	.508
16.0	1.60 "	.374	24.3	6.46 "	.511
17.9	2.03 "	.470	25.8	6.84 "	.543
19.2	2.70 "	.482	26.6	7.95 "	.538

One part of nickel chloride dissolves in 16,000 parts of acetone at 35°, while cobalt chloride is very soluble in this solvent. (Tillu, 1943)

100 cc. of a mixture of equal volumes of diethyl ether and water, saturated with HCl at 0° will dissolve 0.0029 gms. $NiCl_2$. (Fischer and Seidel, 1941).

NICKEL OXIDE NiO

O

Data for the system NiO - ZnO is given by Rigamonti, 1946.

NICKEL HYDROXIDE $Ni(OH)_2$

OH

The solubility product is given as 2.1×10^{-17} by Britton (1935), 1.6×10^{-14} by Wijs (1925), 6.5×10^{-18} by Gayer and Garrett (1949), and 6.2×10^{-16} (Thermodynamic) by Nasanen (1943). The solubility in moles per liter is 1×10^{-4} (Almkvist, 1918) and(Gayer and Garrett, 1949), 9.3×10^{-6} (Oka, 1940).

SOLUBILITY OF NICKEL HYDROXIDE IN SOLUTIONS OF ACID AND BASE AT 25°
(Gayer and Garrett, 1949)

Moles per 1000 gms. H_2O		Moles per 1000 gms. H_2O			
NaOH	$Ni(OH)_2$	HCl	$Ni(OH)_2$	HCl	$Ni(OH)_2$
1.60×10^{-3}	1×10^{-7}	0.0000	0.00010	0.0308	0.0160
1.00×10^{-2}	4×10^{-7}	.0025	.0013	.0447	.0230
1.00×10^{-1}	2×10^{-6}	.0056	.0029	.0523	.0271
1.00	6×10^{-6}	.0100	.0053	.0811	.0413
8.00	7×10^{-6}	.0160	.0083	.1001	.0511
10.00	4×10^{-6}	.0236	.0120		
15.00	5×10^{-6}				

S NICKEL SULFIDE NiS

Dänges (1947) determined the amount of NiS which dissolved under varying conditions of time, reagents added (H_2S, Na_2S, $(NH_4)_2S$) and the concentration of added reagent.

Melting points in the system NiS - FeS are given by Schenck and von der Forst, 1942.

SO NICKEL SULFATE $NiSO_4$

SOLUBILITY OF NICKEL SULFATE IN WATER ABOVE 100°
(Benrath, 1941)

[Solid Phase $NiSO_4 \cdot H_2O$]

t°	Gms. $NiSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $NiSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $NiSO_4$ per 100 gms. Sat. Sol.
150	55.2	195	40	203	25
170	50	203	35	205	10
195	44.2	205	30	205	1

SO NICKEL POTASSIUM SULFATE $NiK_2(SO_4)_2 \cdot 6H_2O$

EQUILIBRIUM IN THE SYSTEM NICKEL POTASSIUM SULFATE - ZINC POTASSIUM SULFATE - WATER AT 25°
(Hill, Durham, and Ricci, 1940)

Saturated Solution Wt. %		Solid Phase Wt. %		Solid
$ZnK_2(SO_4)_2$	$NiK_2(SO_4)_2$	$ZnK_2(SO_4)_2$	$NiK_2(SO_4)_2$	
11.72[a]	0.0	-	-	$ZnK_2(SO_4)_2 \cdot 6H_2O$
10.64	0.456	63.83	11.71	Hexahydrated Solid Solution
9.36	1.030	50.22	25.32	"
7.91	1.695	37.8	37.65	"
6.01	2.660	24.49	50.97	"
3.99	3.78	13.63	61.68	"
0.0	6.33[b]	-	-	$NiK_2(SO_4)_2 \cdot 6H_2O$

[a] density = 1.109

[b] density = 1.056

SO NICKEL AMMONIUM SULFATE $Ni(NH_4)_2(SO_4)_2 \cdot 6H_2O$

7.09 gms. of the anhydrous salt are dissolved in 100 gms. of saturated aqueous solution at 25° (0.2614 molar) density = 1.057. Hill, Durham, and Ricci, 1940).

NICKEL SELENATE $NiSeO_4$

SOLUBILITY OF NICKEL SELENATE IN WATER
(Klein, 1940)

t°	Density	Gms. $NiSeO_4$ per 100 gms. Sat. Sol.	Gms. $NiSeO_4$ per 100 gms. H_2O	Solid Phase
-1.2	1.300	-	-	Ice
-2.1	-	16.09	19.17	Ice + $NiSeO_4 \cdot 6H_2O$
-3.0	-	21.01	26.60	$NiSeO_4 \cdot 6H_2O$
0	1.2675	21.65	27.63	"
15	1.3134	25.06	33.44	"
21.6	1.3351	26.58	36.20	"
30	1.3651	26.58	36.20	"
40	1.4045	31.09	45.11	"
50	1.4473	33.77	50.98	"
60	1.4971	36.81	58.25	"
70	1.5505	39.64	65.67	"
80	1.6154	42.70	74.79	"
90	1.6863	46.54	87.05	"
85.2	1.6332	43.88	78.18	$NiSeO_4 \cdot 4H_2O$
90	1.6434	44.34	79.66	"
95	1.6448	44.85	81.32	"
100	1.6641	45.65	83.99	"
103.6	-	Boiling Point at 745 mm.		

OXYGEN O_2 O

Correction to Volume I, p. 1354 "Solubility of O_2 in Sea Water"

The correct formula is:

$$1000\ a = 10.291 - 0.2809t + 0.006009t^2 - 0.0000632t^3 - Cl(0.1161 - 0.003922t + 0.0000631t^2).$$

SOLUBILITY OF OXYGEN IN WATER
(Cassuto, 1904)

Values for k in the equation $1 = kP$ where 1 is the Ostwald Solubility coefficient and P is the total pressure. Interpolated from the author's data.

Total Pressure Meters	k 23°	k 25.9°	Total Pressure Meters	k -23°	k 25.9°
0.900	-	0.02848	5.000	0.02838	0.02764
1.000	0.02938	.02847	6.000	.02805	.02734
2.000	.02933	.02839	7.000	.02756	.02693
3.000	.02911	.02812	8.000	.02715	.02653
4.000	.02882	.02794			

Braver, 1941 found the solubility of oxygen in metallic columbium to be approximately 0.05 atoms of oxygen per atom of metal.

SOLUBILITY OF OXYGEN IN ORGANIC SOLVENTS

(Kretschmer, Nowaskowska, and Wiebe, 1946)

The results are in terms of the Ostwald Solubility Coefficient and agree well with those of Horiuti (Vol. I, p. 1025). Data for Nitrogen and Air (calculated) are found on p. 364.

Solvent	-25°	0°	25°	50°
Absolute Ethanol	0.2387	0.2409	0.2417	0.2481
95% Vol. % Ethanol (+H_2O)	.1825	.1868	.1917	.2019
Methanol	.2427	.2446	.2476	.2550
Isopropanol	-	.2443	.2463	.2552
n-Butanol	-	.2085	.2100	.2171
Acetone	.2390	.2570	.2794	-
Iso-Octane	.3874	.3701	.3725	.3864
50% Actone by vol. in Ethanol	-	.2409	.2552	.2733
50% Iso-Octane by vol. in Ethanol	-	.3119	.3163	.3225

SOLUBILITY OF OXYGEN IN OILS

(Schaffer and Haller, 1943)

	Ml. O_2 (0°, 760 mm.) per 100 ml. Oil		
	22°	40°	60°
Butter Oil	-	14.2	12.7
Cottonseed Oil	11*	12.7	-
Lard	-	11.5	-
Corn Oil	11*	-	-

*Data of Vibrans, 1935.

SOLUBILITY OF OXYGEN IN RUBBER

(Carpenter, 1947)

The rubber contained 100 parts of smoked sheet rubber by weight, 2.5 parts sulfur, 3.0 parts ZnO, 1.0 parts stearic acid, 0.5 parts each of mercaptobenzthiazole and agrite white. The adsorption was carried out in the dark on a cylindrical piece of the vulcanized product, and diffusion rates were also measured.

Temperature:	21°	25°	30°	35°	40°	45°
Gms. N_2 per cc. Rubber per atm.	-	-	1.21×10^{-4}	1.25×10^{-4}	1.26×10^{-4}	1.29×10^{-4}
cc. N_2 (0°, 760 mm.) per 100 cc. Rubber per atm.	8.3 (7.3)[a]	8.5 (7.9)[b]	-	-	-	-

[a]Venable and Fuwa, 1922

[b]Barrer, 1941

OZONE O_3

SOLUBILITY OF OZONE IN WATER AND CARBON TETRACHLORIDE

(Fischer and Tropsch, 1917)

Solvent	t°	Pressure mm.	% O_3 in Gas	O_3 per liter	
				Mg.	cc.
Water	18	765	6	57.6	27
			100*	980	460
CCl_4	15	760	6	384	179
			100*	6400	3000

*Calculated

Luther, 1905 found the Ostwald Solubility Coefficient of ozone in 0.1N H_2SO_4 to be 0.23 at 20° and 0.44 at 0°.

OSMIUM Os

The distribution of osmium in the system Fe + FeS at the eutectic temperature was determined by Noddack, Noddack, and Bohnstedt, 1940.

PHOSPHORUS (White) P_4

SOLUBILITY OF PHOSPHORUS IN ORGANIC SOLVENTS

(Groot and Hildebrand, 1948)

t°	Gms. P per 100 gms. Solvent	t°	Gms. P per 100 gms. Solvent	t°	Gms. P per 100 gms. Solvent
		Results in n-Heptane			
0	0.86*	33	1.94	71	3.72
25	1.49*	40.4	2.23	78	3.83
32.9	1.89*	42	2.26	84	4.50
40	2.16*	46	2.40	100	5.66
41	2.21*	50	2.62	131	7.58
42	2.23*	63	3.27		
		Results in Carbon Tetrachloride			
0	0.64*	25	1.32	59	2.56
25	1.27*	42	1.89	72	3.16
32.9	1.58*	45	1.96	91	4.10
40	1.82*	48	2.09	94	4.23
41	1.94*	51	2.19	100	4.55
42	1.89*	52	2.28		
		Results in Acetone (Approximate)			
0	0.05*	25	0.14*	40	0.22*

*In equilibrium with solid phosphorus. All other data are for liquid phosphorus.

Data for the solubility of phosphorus in several slightly polar solvents is given by Negisi, 1940.

Br PHOSPHORUS TRIBROMIDE PBr_3

Melting points in the system PBr_3 + Trinitrotoluene are given by Pushin, et al (1947).

O PHOSPHORUS Tri OXIDE P_2O_3

SOLUBILITY OF PHOSPHORUS TRIOXIDE IN ORGANIC SOLVENTS

(Semenchenko and Shakparonov, 1948)

t°	Solvent	Moles P_2O_3 per 100 moles Sat. Sol.	t°	Solvent	Moles P_2O_3 per 100 moles Sat. Sol.
15	C_6H_6	0.067	15	C_2H_5OH	0.005
10	CS_2	.956	15	Glycerin	.007
15	$(C_2H_5)_2O$	.022			

PO PHOSPHORIC ACID H_3PO_4

EQUILIBRIUM IN THE SYSTEM PHOSPHORIC ACID - ETHER - WATER AT 23°

(Bachelet, Cheylan, and Le Bris, 1947)

Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.		Gms. per 100 gms. Sat. Sol.	
H_3PO_4	$(C_2H_5)_2O$	H_3PO_4	$(C_2H_5)_2O$	H_3PO_4	$(C_2H_5)_2O$
0.0	98.76	40.10	40	48.30	12.10
16.14	80.72	42.70	34.70	46.75	7.88
26.98	67.40	43.80	29.10	31.30	7.80
30.70	61.40	44	27.50	15.85	7.70
33.68	56	45.60	22.80	3.04	7.50
37.10	46.30	47.70	15.90	0.0	6.53

DISTRIBUTION OF PHOSPHORIC ACID BETWEEN ETHER AND WATER AT 23°

(Bachelet, Cheylan, and Le Bris, 1947)

Gms. H_3PO_4 per 100 gms.		Gms. H_3PO_4 per 100 gms.		Gms. H_3PO_4 per 100 gms.	
H_2O	$(C_2H_5)_2O$	H_2O	$(C_2H_5)_2O$	H_2O	$(C_2H_5)_2O$
34.8	0.01	88.3	0.50	136.5	1.78
55.5	.076	105	.95	130.8	1.41
82	.26	116	1.17		

PO PHOSPHOMOLYBDIC ACID $H_3PO_4 \cdot 12MoO_3 \cdot nH_2O$

Souchay, 1945 studied the systems phosphomolybdic acid - ether - water and phosphomolybdic acid - sulfuric acid - ether - water at 23.8° and found $H_3PO_4 \cdot 12MoO_3 \cdot 30H_2O$ to be the stable phase in water solution at this temperature. The saturated solution contains 52 wt. % $H_3PO_4 \cdot 12MoO_3$. In solutions containing 24 - 33 wt. % $(C_2H_5)_2O$, $H_3PO_4 \cdot 12MoO_3 \cdot 14H_2O$ is the stable phase.

Pb

LEAD Pb

Data are given for the distribution of the metal and salt phases in in the following systems:

$Pb + SnCl_2 \rightleftharpoons Sn + PbCl_2$ at 600° (Körber and Oelson, 1932)
at 550° (Jander and Striebich, 1937)
at 500°, 600° (Lorenz and Schulz, 1928b)

$Pb + SnBr_2 \rightleftharpoons Sn + PbBr_2$ at 400° (" " " , 1928a)

$Pb + 2TlCl \rightleftharpoons 2Tl + PbCl_2$ at 500° (Lorenz and Schmitt, 1930)

$Pb + ZnCl_2 \rightleftharpoons Zn + PbCl_2$ at 580° (Jellinek and Siewers, 1932)
(Urazov and Sokolova, 1944)

$2Pb + Ag_4P_2O_7 \rightleftharpoons Ag + Pb_2P_2O_7$ at 1200° (Jellinek and Siewers, 1932)

$Pb + SnS \rightleftharpoons Sn + PbS$ at 910° (Anderson and Ridge, 1943)

0.0417 wt. % of lead will dissolve in molten lead chloride at 700°. (Karpachev, Stromberg, and Jordan, 1942)

Studies on the corrosion of lead by sulfuric and nitrosylsulfuric acids were made by Adaduroff and Bauman, 1935.

The solubilities of various porcelain glazes containing lead in vinegar and citric acid solutions with varying conditions of exposure was determined by Geller and Creamer, 1939.

LEAD ARSENATE $PbHAsO_4$

AsO

The solubility of $PbHAsO_4$ in various body fluids was determined by Fairhall, 1939.

LEAD BROMIDE $PbBr_2$

Br

Melting point data are given for the following systems:

$PbBr_2 + PbI_2$ (Delgery, 1946)

$PbBr_2 + PbCl_2$ (" ") (Favorskii, 1940)

LEAD ACETATE (ous) $Pb(C_2H_3O_2)_2$

CH

100 gms. of a saturated solution in furfural at 25° contain 0.06 gms. $Pb(C_2H_3O_2)_2$.

100 gms. of a saturated solution in furfural at 25° contain 0.05 gms. $Pb(C_2H_3O_2)_2 \cdot 3H_2O$.

(Trimble, 1941)

CH LEAD ACETATE (ic) $Pb(C_2H_3O_2)_4$

SOLUBILITY OF PLUMBIC ACETATE IN ANHYDROUS ACETIC ACID

(Davidson, Lanning, and Zeller, 1942)

t°	Mole % $Pb(C_2H_3O_2)_4$	Solid Phase	t°	Mole % $Pb(C_2H_3O_2)_4$	Solid Phase	t°	Mole % $Pb(C_2H_3O_2)_4$	Solid Phase
16.60	0.0	A	29.9	0.512	B	68.4	1.64	B
16.52	0.088	A	33.5	.582	B	74.6	1.96	B
16.45	.193	A	37.0	.638	B	82.3	2.55	B
16.40	.280	A	45.0	.798	B	90.7	3.31	B
18.2	.354	B	53.0	1.03	B	94.4	3.74	B
25.2	.427	B	59.8	1.29	B			

A = $HC_2H_3O_2$ B = $Pb(C_2H_3O_2)_4$

SOLUBILITY OF PLUMBIC ACETATE IN ACETIC ACID - SODIUM ACETATE SOLUTIONS

(Davidson, Lanning, and Zeller, 1942)

R = Mole % $NaC_2H_3O_2$ in Solvent ($NaC_2H_3O_2$ + $HC_2H_3O_2$)

Mole % $Pb(C_2H_3O_2)_4$ in Sat. Sol.	t°	Mole % $Pb(C_2H_3O_2)_4$ in Sat. Sol.	t°	Mole % $Pb(C_2H_3O_2)_4$ in Sat. Sol.	t°
R = 0.003		R = 0.007		R = 0.015	
0.390	24.1	0.404	25.2	0.394	25.7
.417	26.2	.425	27.3	.445	28.3
.460	28.3	.523	34.5	.457	30.2
.501	31.7	.589	38.3	.489	31.6
.525	32.8	.654	40.8	.524	34.7
.560	34.7	.688	42.6	.586	38.1
.638	38.8	.772	46.0	.607	39.3
R = 0.025		R = 0.050		R = 0.07	
0.321	22.5	0.266	23.1	0.339	32.1
.446	32.7	.294	26.3	.368	34.3
.507	36.2	.356	31.9	.379	36.3
.597	41.3	.451	37.8	.429	40.5
.634	43.2	.471	39.0	.461	42.8

Results in Solutions at 30°

R =	0.0	0.003	0.007	0.015	0.025	0.050	0.070
S =	0.51	0.48	0.46	0.45	0.41	0.33	0.31

CH LEAD MONOCHLORACETATE $Pb(CH_2ClCO_2)_2$

SOLUBILITY IN WATER

(Grillot, 1949)

The results were read from a curve drawn by the author.

Temperature°	20	40	60	80
Moles $Pb(CH_2ClCO_2)_2$ per 100 cc.	0.004	0.012	0.020	0.029

CH

LEAD ETHYL XANTHATE $Pb(C_2H_5OCS_2)_2$

The solubility of lead ethyl xanthate is 5.5×10^{-6} moles per liter.
(Taggart and Hassialis, 1946)

C_6H

LEAD PICRATE $Pb(C_6H_2(NO_2)_3O)_2$

Lead picrate is soluble to the extent of 3% in acetonitrile at 25°.
(Pleskov, 1948)

C_8H

LEAD ISATIN OXIME $PbC_8H_4N_2O_2$ [2]

At 18 - 20°, 1 mg. of coarse or 2 mg. of finely divided salt dissolve in one liter of water.

At 18 - 20°, about 6.4 mg. dissolve in dilute (1:30) NH_3 [per liter] (coarse form).

At 18 - 20°, about 13 mg. dissolve in concentrated NH_3 [" "] (coarse form).

(Hovorka and Divis, 1949)

$C_{14}H$

LEAD ANTHRACENE SULFONATES $Pb(C_{14}H_9SO_3)_2$ $Pb(C_{14}H_8S_2O_6)$

SOLUBILITY IN WATER
(Federov and Lodygin, 1942)

Salt	Gms. per 100 gms. Sat. Sol. 20°	100°	Salt	Gms. per 100 gms. Sat. Sol. 20°	100°
α-$Pb(C_{14}H_9SO_3)_2 \cdot 2H_2O$	0.060	0.448	1,8-$PbC_{14}H_8S_2O_6 \cdot 2H_2O$	0.019	0.091
β-$Pb(C_{14}H_9SO_3)_2 \cdot 2H_2O$	.007	.041	2,6-$PbC_{14}H_8S_2O_6 \cdot 4H_2O$	.048	.141
1,5-$PbC_{14}H_8S_2O_6 \cdot 2H_2O$	.218	1.033	2,7-$PbC_{14}H_8S_2O_6 \cdot 3H_2O$	.797	3.728

CO

LEAD CARBONATE (Basic)

Data for the solubility of basic lead carbonate in various salt solutions of very low concentration is given by Ruchoft and Kachmar, 1942.

COO

LEAD OXALATE PbC_2O_4

SOLUBILITY OF LEAD OXALATE IN POTASSIUM OXALATE SOLUTIONS AT 26°
(Kolthoff, Perlich, and Weiblen, 1942)

Moles $K_2C_2O_4$ per liter	Moles x 10^5 PbC_2O_4 per liter	Mg. Pb per liter	Moles $K_2C_2O_4$ per liter	Moles x 10^5 PbC_2O_4 per liter	Mg. Pb per liter
0.0	.2.2	4.5	0.075	12	24
.001	1.8	3.7	.100	16	32
.005	1.5	3.0	.200	35	72
.010	2.2	4.3	.400	66	135
.025	4.1	8.4	.500	85	175
.050	8.5	17.4			

CO

SOLUBILITY OF LEAD OXALATE IN AQUEOUS ETHANOL SOLUTIONS AT 25°

(Kolthoff, Perlich, and Weiblen, 1942)

% Alcohol	10	20	30
Moles PbC_2O_4 per liter	8.2×10^{-5}	4.2×10^{-6}	1.2×10^{-6}
Mg. Pb per liter	1.7	0.85	0.24

Cl

LEAD CHLORIDE $PbCl_2$

SOLUBILITY OF LEAD CHLORIDE IN WATER

(Goulden and Hill, 1946)

The results are averages of several determinations at each temperature in which both Pb and Cl were determined analytically.

Temperature°	15	20	25	30	35
Gms. $PbCl_2$ per 100 gms. Sat. Sol.	0.866	0.968	1.075	1.179	1.298

SOLUBILITY OF LEAD CHLORIDE IN WATER - DEUTERIUM OXIDE MIXTURES AT 25°

(Noonan, 1948)

% D_2O	Moles $PbCl_2$ per 100 moles Solvent
91.6	0.0471
100.0	.0449

SOLUBILITY OF LEAD CHLORIDE IN CALCIUM CHLORIDE SOLUTIONS

(Tschischikoff and Schachoff, 1936)

Results at 25°			Results at 60°		
Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$CaCl_2$	$PbCl_2$		$CaCl_2$	$PbCl_2$	
0.0	1.031	$PbCl_2$	0.0	1.887	$PbCl_2$
0.35	0.576	"	0.35	1.368	"
0.653	.382	"	0.67	1.068	"
1.25	.227	"	1.28	0.757	"
2.44	.164	"	2.56	.520	"
4.83	.12	"	4.17	.478	"
9.16	.156	"	10.51	.489	"
17.18	.31	"	17.43	.914	"
29.9	2.226	"	19.46	3.69	"
42.3	6.36	$PbCl_2$ + $CaCl_2$	44.48	7.265	

SOLUBILITY OF LEAD CHLORIDE IN ZINC CHLORIDE SOLUTIONS

(Tschischikoff and Schachoff, 1936)

Results at 25°			Results at 60°		
Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$ZnCl_2$	$PbCl_2$		$ZnCl_2$	$PbCl_2$	
0.0	1.031	$PbCl_2$	0.0	1.887	$PbCl_2$
0.49	0.513	"	2.05	0.69	"
.8	.3	"	3.96	.54	"
.727	.252	"	7.68	.48	"
.846	.22	"	14.52	.45	"
12.54	.161	"	26.52	.31	"
16.72	.09	"	43.71	.147	"
26.00	.08	"	47.41	.195	"
37.21	.10	"	66.16	.215	"
47.91	.14	"	69.29	.345	"
55.33	.17	"	80.96	3.86	$PbCl_2 + ZnCl_2$
66.68	.184	"			
76.68	.696	"			
80.05	.78	$PbCl_2 + ZnCl_2$			

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS ETHYLENE GLYCOL SOLUTIONS AT 25°

(Garrett, Noble, Kiefer, and Bryant, 1943)

Wt. % Glycol in Solvent	Gms. $PbCl_2$ per 100 gms. Solvent	Wt. % Glycol in Solvent	Gms. $PbCl_2$ per 100 gms. Solvent	Wt. % Glycol in Solvent	Gms. $PbCl_2$ per 100 gms. Solvent
0.0	1.086	20.00	1.065	81.6	1.293
5.44	1.073	21.75	1.065	85.4	1.326
6.54	1.073	30.00	1.079	87.3	1.360*
7.62	1.068	40.00	1.106	89.4	1.277*
8.72	1.065	42.57	0.945	91.7	1.188*
9.80	1.065	50.00	1.141	93.3	1.129*
10.00	1.058	60.0	1.175	94.8	1.070*
10.88	1.068	62.4	1.195	96.5	1.001*
11.97	1.065	70.0	1.226	100	0.859*
13.07	1.068	80.0	1.270		

*Solid Phase: $PbCl_2 \cdot 2C_2H_4(OH)_2$. Solid Phase in all other solutions is $PbCl_2$.

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS 1, 2-PROPYLENE GLYCOL SOLUTIONS AT 25°

(Garrett, Noble, Kiefer, and Bryant, 1943)

Wt. % Glycol in Solvent:	20.5	40.8	60.8	80.5	100.0
Gms. $PbCl_2$ per 100 gms. Solvent:	0.812	0.606	0.481	0.345	0.253

Cl

SOLUBILITY OF LEAD CHLORIDE IN MIXED SOLVENTS AT 25°

(Noble and Garrett, 1944)

Grams $PbCl_2$ per 100 gms. of Solvent

Wt. % H_2O in Solvent	Dioxane-Water	Ethanol-Water	Acetone-Water	Glycerol-Water
100	1.086	1.086	1.086	1.086
90	0.807	0.662	0.737	1.124
80	.604	.392	.484	1.168
70	.401	.246	.301	1.220
60	.259	.158	.178	1.270
50	.153	.100	.0973	1.332
40	.0898	.0598	.0456	1.401
30	.0584	.0309	.0178	1.482
20	.0334	.0139	.0045	1.573
10	.0167	.0058	.0026	1.689
0	.0036	.0021	.0011	1.822

Cl

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS UREA AND DIOXANE SOLUTIONS AT 18°

(Pederson, 1941)

Moles Urea per liter Solvent	Moles $PbCl_2$ per liter Sat. Sol.	Moles Dioxane per liter Solvent	Moles $PbCl_2$ per liter Sat. Sol.
0.0	0.03367	0.0	0.03360
0.250	.03542	0.167	.03232
.500	.03728	.333	.03113
.750	.03922	.500	.02992
1.000	.04120	.667	.02875
		1.000	.02647

SOLUBILITY OF LEAD CHLORIDE IN UREA AND GLYCINE SOLUTIONS AT 25°

(Dunning and Shutt, 1938)

Aqueous Urea Solutions

Moles per liter	
Urea	$PbCl_2$
0.0	0.03850
1.0	.04669
2.5	.06131
5.0	.09539

Aqueous Glycine Solutions

Moles per liter	
Glycine	$PbCl_2$
0.2	0.03851
.4	.05765
.5	.07840
.6	.08775
.8	.1115

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS ETHYLENE GLYCOL SOLUTIONS CONTAINING POTASSIUM CHLORIDE AT 25°

(Garrett, Bryant, and Kiefer, 1948)

Moles per 1000 gms. Solvent		Moles per 1000 gms. Solvent		Moles per 1000 gms. Solvent	
$PbCl_2$	KCl	$PbCl_2$	KCl	$PbCl_2$	KCl
Solvent: 21.75 Wt. % Glycol		Solvent: 42.57 Wt. % Glycol		Solvent: 62.44 Wt. % Glycol	
0.03821	0.0	0.04016	0.0	0.04296	0.0
.03187	0.0196	.03440	0.0192	.02429	.0756
.02690	.0392	.02882	.0382	.01518	.1879
.01951	.0783	.02158	.0765	.00524	.4750
.01733	.0995	.01456	.1534	.00336	.7678
.01080	.1968	.01288	.1922	.00323	1.1678
.00682	.4972	.00700	.3868		
.00482	.8098	.00400	.7837	Solvent: 81.64 Wt. % Glycol	
.00402	1.222	.00345	1.194		
.00496	2.096	.00395	2.054	0.04635	0.0
				.04043	0.0185
Solvent: 100% Ethylene Glycol				.03578	.0370
				.02856	.0735
0.03086	0.0	0.01566	0.0910	.01491	.1848
.02506	0.0189	.01319	.1452	.00493	.4668
.01999	.0440	.01227	.1821		
.01672	.0727				

SOLUBILITY OF LEAD CHLORIDE IN AQUEOUS DIOXANE SOLUTIONS AT 25°

(Noble and Garrett, 1944)

All concentrations are moles salt per 1000 gms. of Solvent.

KCl	$PbCl_2$	KCl	$PbCl_2$	KCl	$PbCl_2$	KCl	$PbCl_2$
In 20 Wt. % Dioxane		0.711	0.00325	0.0294	0.00442	In 60 Wt. % Dioxane	
		.868	.00314	.0688	.00348		
0.0	0.02173	.970	.00312	.099	.00336	0.0	0.00323
0.01005	.0184	1.180	.00323	.199	.00335	0.010	.00208
.03016	.0133	1.455	.00371	.295	.00312	.030	.00204
.0695	.00874	1.674	.00418	.399	.00252	.050	.00210
.0995	.00725			.693	.00225	.070	.00207
.199	.00537	In 40 Wt. % Dioxane		.859	.00211	.085	.00198
.299	.00509			1.008	.00254	.100	.00154
.401	.00437	0.0	0.00932	1.224	.00283	.300	.00135
.553	.00353	0.0098	.00660				

	$PbCl_2$		
KNO_3	20 Wt. % Dioxane	40 Wt. % Dioxane	60 Wt. % Dioxane
0.005		0.00932	0.00505
.010		.01011	.00756
.030	0.02323	.01222	
.050	.02445	.01352	
.070	.02584	.01486	
.085	.02772	.01539	
.100	.02869	.01605	
.300	.03145	.02382	

Cl

Cl The solubility of $PbCl_2$ in AgCl and AgCl + $CdCl_2$ at 270° was determined by Wagner and Zimens, 1947.

Melting points in the systems $PbCl_2$ - $ZnCl_2$, $PbCl_2$ - KCl, and $PbCl_2$ - $ZnCl_2$ - KCl are given by Ugai and Shatillo (1949), and for the system $PbCl_2$ + PbI_2 by Delgery (1946).

ClO LEAD PERCHLORATE $Pb(ClO_4)_2$

A saturated solution of lead perchlorate in acetonitrile contains 10% $Pb(ClO_4)_2$ at 25°. (Pleskov, 1948)

CrO LEAD CHROMATE $PbCrO_4$

The solubility in water is 5.3×10^{-7} moles per liter at 25°. (Kolthoff, Perlich, and Weiblen, 1942)

1.27×10^{-4} moles of $PbCrO_4$ dissolve in one liter of 0.1 M $HClO_4$. (May and Kolthoff, 1948). The authors found the solubility of freshly precipitated $PbCrO_4$ to be considerably greater than that of aged samples, and measured the specific surface area of each type.

F LEAD FLUORIDE PbF_2

SOLUBILITY OF LEAD FLUORIDE IN AQUEOUS SALT SOLUTIONS AT 18° - 20°
(Golovatyj, 1940)

Millimoles PbF_2 per liter

KF (N)	0.1 N KNO_3	0.2 N KNO_3	0.5 N KNO_3
0.0	2.148	2.353	3.431
0.008	1.438	2.030	2.816
.016	1.154	1.526	2.723
.032	0.715	0.992	.880
.064	.342	.603	.732
.128	.224	.412	.438
.256	.239	.473	.504
.362	.315	.514	.527

Data for the solubility of PbF_2 in AlF_3 solutions at 25° is given by Scott, 1947.

I LEAD IODIDE PbI_2

Correction to Vol. I, p. 1398:

"Solubility of Lead Iodide in Water", Lichty, 1903; Each figure in the last two columns (millimoles PbI_2 per 100 cc. of Solution and 100 gms. of H_2O) should be multiplied by ten. [i.e: 0° reads 0.096 and should read 0.96.]

The solubility product of lead iodide was determined from 5° to 60° in perchlorate solutions by Näsänen, 1944, 1945.

SOLUBILITY OF LEAD IODIDE IN POTASSIUM IODIDE SOLUTIONS AT 25°

(Lanford and Kiehl, 1941)

I

Moles per 1000 gms. H_2O		Moles per 1000 gms. H_2O		Moles per 1000 gms. H_2O	
KI	PbI_2	KI	PbI_2	KI	PbI_2
0.0	164.1×10^{-5}	0.125	4.06×10^{-5}	0.275	7.30×10^{-5}
.010	28.1	.150	4.42	.300	8.17
.030	6.53	.175	4.90	.325	9.20
.060	4.60	.200	5.49	.350	10.23
.080	4.23	.225	5.98	.400	13.32
.100	4.01	.250	6.75		

SOLUBILITY OF LEAD IODIDE IN AQUEOUS SALT SOLUTIONS AT 18° - 20°

(Golovatyj, 1940)

Millimoles PbI_2 per liter

KI (N)	KNO_3						$Ca(NO_3)_2$	
	0	0.1 N	0.2 N	0.5 N	1 N	1.5 N	0.1 N	0.2 N
0.0	1.442	1.601	1.917	2.296	2.632	3.240	2.662	2.534
0.008	0.347	0.554	0.862	1.686	1.965	2.940	1.632	1.594
.016	.154	.328	.609	1.432	1.692	2.659	0.995	.912
.032	.206	.214	.462	0.950	1.284	1.973	.404	.400
.064	.286	.322	.382	.742	0.862	1.328	.485	.494
.128	.307	.480	.501	.583	.742	0.918	.562	.532
.256	.413	.612	.654	.714	.624	.890	.930	.918
.340	.473				.649	.898		

LEAD IODATE $Pb(IO_3)_2$

IO

SOLUBILITY OF LEAD IODATE IN AMMONIUM ACETATE SOLUTIONS AT 25°

(Edmonds and Birnbaum, 1940)

The solutions were prepared of unit ionic strength.

Moles per liter			Moles per liter		
$NH_4C_2H_3O_2$	NH_4ClO_4	$Pb(IO_3)_2$	$NH_4C_2H_3O_2$	NH_4ClO_4	$Pb(IO_3)_2$
0.0	1.00	1.950×10^{-4}	0.10	0.90	4.370×10^{-4}
.01	0.99	2.842	.20	.80	5.584
.02	.98	3.036	.50	.50	7.265
.05	.95	3.557	1.00	0.0	9.11

SOLUBILITY OF LEAD IODATE IN WATER AND AMINO ACID SOLUTIONS AT 25°

(Keefer and Reiber, 1941)

Two samples of lead iodate were prepared; one (I) by mixing $Pb(NO_3)_2$ solution with KIO_3 in a total volume of about 3 liters. The other (II) was prepared by the method of La Mer and Goldman (Vol. I, p. 1400) in which a much larger volume of water is used and no excess of K^+ NO_3^- is allowed to accumulate. The solubility of the first sample in water was 5.34×10^{-5} moles per liter, in agreement with that found by Kohlrausch and by Harkins and Winninghoff (both Vol. I, p. 1400). The solubility

of the second sample was identical with the similarly prepared sample of La Mer and Goldman: 3.61×10^{-5} L. and G. attributed this difference to the increased purity of their salt. The present authors feel that the
IO difference in particle size explains the variation. Results given below are in moles per 1000 gms. of water.

Results in Glycine Solutions				Results in Alanine Solutions			
Preparation I		Preparation II		Preparation I		Preparation II	
G	$Pb(IO_3)_2 \times 10^5$	G	$Pb(IO_3)_2 \times 10^5$	A	$Pb(IO_3)_2 \times 10^5$	A	$Pb(IO_3)_2 \times 10^5$
0.00502	5.47	0.0249	4.05	0	5.34	0	3.61
.01003	5.63	.0499	4.45	0.01081	5.56	0.0248	4.05
.01505	5.65	.0749	4.81	.01521	5.65	.0495	4.66
.02510	6.15	.100	5.09	.02163	5.69	.075	5.06
.05026	6.40			.02704	6.08	.100	5.57
.08052	6.75			.05419	6.30		
.10074	7.51			.08142	7.17		
.1210	7.70						
.2023	9.41						

O LEAD OXIDE PbO

Data are given for the following systems:

PbO - PbS	Melting points	(Kohlmeyer and Monzer, 1943)
PbO - PbS - Pb	at 1050°	(" " " ")
PbO - $PbSO_4$ - Pb	at 1050°	(" " " ")
PbO - B_2O_3 - SiO_2	Melting points and refractive indices	(Geller and Bunting, 1939)
PbO - SiO_2	Surface tension	(Shartis, Spinner, and Smock, 1948)
	By X-rays	(McMurdie and Bunting, 1939)
PbO - $PbSO_4$	Melting points	(Lander, 1949)

OH LEAD HYDROXIDE (ous) $Pb(OH)_2$ (ic) $Pb(OH)_4$

The solubility of $Pb(OH)_2$ in water is 4.8×10^{-6} moles per liter.
" " " $Pb(OH)_4$ " " " 2.6×10^{-14} " " "
(Oka, 1940)

S LEAD SULFIDE PbS

The solubility product, calculated from thermodynamic data, was found by Kapustinsky, 1940 to be 6.8×10^{-29}. The calculated solubility in solutions of varying acidity is as follows: (25°)

pH:	3	5	7	9	11
Gm. moles per liter.	7.9×10^{-7}	8×10^{-9}	1.1×10^{-10}	8.2×10^{-12}	8.2×10^{-13}

Melting points in the systems PbS - Sb_2S_3 are given by Savul, 1940.

LEAD SULFATE $PbSO_4$

SOLUBILITY OF LEAD SULFATE IN SULFURIC ACID SOLUTIONS
(Craig and Vinal, 1939)

The purest lead sulfate and water were used. Analysis for lead was made by a carefully checked dithizone method, and the original data fall on a smooth curve. The following rounded results are given by the authors. The data agree with and extend those of Purdam and Rutherford (Vol. I, p. 1412).

Wt. % H_2SO_4	Mg. $PbSO_4$ per liter Saturated Solution	
	25°	0°
0.1	4.99	2.37
.2	4.61	2.13
.3	4.55	2.07
.4	4.57	2.05
.5	4.60	2.06
.6	4.65	2.06
.7	4.71	2.07
.8	4.77	2.07
.9	4.84	2.08
1.0	4.91	2.10
2.0	5.37	2.18
3.0	5.70	2.27
4.0	5.95	2.36
5.0	6.15	2.46
6.0	6.33	2.58
7.0	6.47	2.69
8.0	6.57	2.79
9.0	6.64	2.84
10.0	6.68	2.86
15.0	6.28	2.63
20.0	5.18	2.21
25.0	3.87	1.76
30.0	2.82	1.27
35.0	2.02	0.84
40.0	1.52	.53
45.0	1.23	-
50.0	1.08	-

SOLUBILITY OF LEAD SULFATE IN SULFURIC ACID SOLUTIONS AT 25°
(Kryukova, 1939)

Results determined polaragraphically.

Gms. H_2SO_4 per liter	0.049	0.245	4.90	49.0
Gms. $PbSO_4$ per liter	0.0155	0.0089	0.0042	0.0045

SOLUBILITY OF LEAD SULFATE IN SOLUTIONS OF ELECTROLYTES AT 18° - 20°
(Golovatyj, 1940)

Results are in millimoles $PbSO_4$ per liter.

Gm. Equiv. K_2SO_4 per liter	0.0	0.004	0.008	0.016	0.032	0.064	0.128
H_2O	0.139	0.0952	0.0784	0.0530	0.0544	0.108	0.114
0.01 N HNO_3	.386	.209	.184	.170	.227	.283	.504
.05 N "	.646	.382	.342	.284	.324	.417	.709
.1 N "	1.157	.957	.632	.514	.543	.687	.762
.5 N "	1.360	1.328	1.111	.923	.687	.634	.742
.01 N KOH	0.231	0.207	0.189	.217	.286	.344	.481
.05 N "	1.407	1.233	1.1331	1.2342	1.534	1.571	1.604
.1 N KNO_3	0.407	-	0.146	0.135	0.124	0.204	0.214
.2 N "	.461	-	0.284	.207	.179	.184	.234
1.0 N "	2.289	-	1.365	.822	.544	.6-98	.734

SOLUBILITY OF LEAD SULFATE IN SOLUTIONS OF ELECTROLYTES AT 25°

(Kolthoff, Perlich, and Weiblen, 1942)

In Sodium Sulfate Solutions		In Sulfuric Acid Solutions		In 0.01 M Na_2SO_4 Solutions with added $NaNO_3$	
Moles per liter		Moles per liter		Moles per liter	
Na_2SO_4	$PbSO_4$	H_2SO_4	$PbSO_4$	$NaNO_3$	$PbSO_4$
0.0	15.2×10^{-5}	0.001	3.6×10^{-5}	0.0	1.5×10^{-5}
0.001	2.4	.005	2.2	0.0500	2.6
.01	1.6	.0075	2.2	.100	3.9
.02	1.4	.010	1.8	.500	17
.04	1.3	.025	1.8	1.00	47
.08	1.3	.050	1.7		
.100	1.6	.100	1.6		
.200	1.9	.250	1.8		
.350	2.3	.500	2.1		
.500	2.3				

SO

Data for the solubility of lead sulfate in various salt solutions of very low concentration are given by Ruchhoff and Kachmar, 1942.

$PbSO_4$ is 733 times as soluble in 3N $NaNO_3$ solution as is water.

(Belfiori, 1940)

SOLUBILITY OF LEAD SULFATE IN AQUEOUS ETHANOL SOLUTIONS AT 25°

(Kolthoff, Perlich, and Weiblen, 1942)

Volume % C_2H_5OH	Mg. Pb per liter	Moles $PbSO_4$ per liter	Volume % C_2H_5OH	Mg. Pb per liter	Moles $PbSO_4$ per liter
0	30	15×10^{-5}	40	0.51	0.25×10^{-5}
10	11.0	5.4	50	.32	.16
20	4.2	2.1	60	.20	.10
30	1.5	0.76	70	.06	.03

SOLUBILITY OF LEAD SULFATE IN ETHANOLIC SODIUM SULFATE SOLUTIONS AT 25°

(Kolthoff, Perlich, and Weiblen, 1942)

Moles Na_2SO_4 per liter 50% C_2H_5OH by Volume:	0.0	0.001	0.005	0.010	0.100
Mg. Pb per liter:	0.32	0.26	0.24	0.17	0.25
Moles $PbSO_4$ per liter:	1.6×10^{-6}	1.3×10^{-6}	1.2×10^{-6}	0.82×10^{-6}	1.22×10^{-6}

SOLUBILITY OF LEAD SULFATE IN AQUEOUS ETHANOL SOLUTIONS

(Kolzaml, 1948)

% C_2H_5OH	Density at 20°	Moles $PbSO_4$ per liter		
		20°	25°	30°
0.0	0.99823	14.21×10^{-5}	14.81×10^{-5}	15.44×10^{-5}
3.698	.99156	8.95	10.12	10.76
7.804	.98508	5.72	6.09	6.26

SOLUBILITY OF LEAD SULFATE IN AQUEOUS DIOXANE SOLUTIONS
(Kolzaml, 1947)

% Dioxane	Density at 20°	Moles $PbSO_4$ per liter		
		20°	25°	30°
0.0	0.99823	14.21×10^{-5}	14.81×10^{-5}	15.44×10^{-5}
2.649	.99994	11.66	12.10	12.74
5.178	1.00174	10.34	10.96	11.52

LEAD SULFAMATE $Pb(SO_3NH_2)_2$ SO

Cupery (1938) found the solubility to be 218 gms. per 100 gms. of water at 25°.

LEAD SELENITE $PbSeO_3$ SeO

After seven days agitation at 10°, 11 mg. of $PbSeO_3$ were found to be dissolved in 100 cc. of water. (Dolique, 1943)

LEAD TUNGSTATE $PbWO_4$ WO

The solubility in water at 25° is 0.0159 gms. per liter of saturated solution. (Berkem, 1943)

PALLADIUM Pd Pd

The distribution of metallic palladium in the system Fe + FeS at the eutectic temperature was studied by Noddack, Noddack, and Bohnstedt (1940)

PALLADIUM IODIDE PdI_2 I

SOLUBILITY OF PALLADIUM IODIDE IN POTASSIUM IODIDE SOLUTIONS AT 18°
(Tananaev, 1948)

The solid phase is anhydrous PdI_2

Moles per liter		Moles per liter		Moles per liter	
KI	PdI_2	KI	PdI_2	KI	PdI_2
0.10	1.4×10^{-5}	0.21	6.4×10^{-5}	0.28	1.1×10^{-4}
.12	2.5	.224	7.6	.36	2.14
.16	4.6	.228	8	.44	2.5
.18	5.2	.232	8.8	.60	4.7
.20	5.6	.236	9.4	1.00	1.3×10^{-3}

Cl PRASEODYMIUM CHLORIDE $PrCl_3$

SOLUBILITY OF PRASEODYMIUM CHLORIDE IN WATER
(Friend and Hale, 1940)

t°	Gms. $PrCl_3$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $PrCl_3$ per 100 gms. Sat. Sol.	Solid Phase
0	47.75	$PrCl_3 \cdot 7H_2O$	45.8	51.47	$PrCl_3 \cdot 7H_2O$
11.4	48.39	"	55.4	53.04	"
13.0	50.96*	"	59.0	53.60	"
26.2	49.65	"	63.6	54.51	"
35.0	50.15	"	71.5	56.62	"
44.6	51.46	"	80.2	58.62	"

*Matignon, (1906)

NO PRASEODYMIUM NITRATE $Pr(NO_3)_3$

DISTRIBUTION OF PRASEODYMIUM NITRATE BETWEEN WATER AND n-HEXYL ALCOHOL AT 25°
(Templeton, 1949)

Wt. % Pr_6O_{11} in		Wt. % Pr_6O_{11} in	
Aqueous Phase	Alcohol Phase	Aqueous Phase	Alcohol Phase
28.75	2.71	25.35	0.99
28.7	2.68	23.9	.74
28.4	2.36	22.6	.51
26.05	1.43	21.3	.35
25.4	1.09	20.25	.25

WO PRASEODYMIUM TUNGSTATE $Pr_2(WO_4)_3$

SOLUBILITY OF PRASEODYMIUM TUNGSTATE IN WATER
(Vickery, 1949)

t°	Gms. $Pr_2(WO_4)_3$ per 100 ml.	
	Unignited	Ignited
20	0.020	0.002
100	.025	.002

Pt PLATINUM Pt

The distribution of metallic platinum between Fe and FeS at the eutectic temperature of the system was studied by Noddack, Noddack, and Bohnstedt, 1940.

SOLUBILITY OF PLATINUM IN MERCURY
(Plaksin and Suvorovskaya, 1940, 1941, 1946)

The system platinum - mercury was studied by thermal, X-ray, and microscopic methods and the phase diagrams drawn. Mercury dissolves in platinum up to 23 atomic %, and forms 3 compounds. The solubility of platinum in mercury is as follows:

Temperature:	16.5°	144°	200°
Atomic % Pt	0.0205	1.08	1.77

PLATINUM AMMINE THIOCYANATE $Pt(NH_3)_4[Pt(CNS)_4]$ (?) CNS

Solvent	Gms. per 100 gms. Sat. Sol.
50% Acetone	2
50% Acetone saturated with benzene	1.5

(Grinberg and Zemlyakova, 1948)

PLATINUM CHLORIDE $PtCl_4$ Cl

SOLUBILITY OF PLATINUM CHLORIDE IN WATER
(Kurnakov and Nikitina, 1940)

t°	Gms. $PtCl_4$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $PtCl_4$ per 100 gms. Sat. Sol.	Solid Phase
0	39.99	$PtCl_4 \cdot 8H_2O$	70	74.66	$PtCl_4 \cdot 4H_2O$
25	58.70	(?)	80	78.60	$PtCl_4 \cdot 3H_2O$
40	62.38	$PtCl_4 \cdot 5H_2O$	90	82.5	"
50	69.03	"	98	85.11	"
60	74.00	$PtCl_4 \cdot 4H_2O$			

RADIUM EMANATIONS

A complete list of references for the solubility of radium emanations in various solvents is given by Markham and Kobe, 1941b.

RADIUM NITRATE $Ra(NO_3)_2$ NO

The distribution of radium nitrate between liquid and solid salts at their melting points was determined by Chlopin and Klokman, 1949 for the following cases: in $Pb(NO_3)_2$ with $NaNO_3$ added, in $Ba(NO_3)_2$ with $NaNO_3$ added, in $PbSO_4$ with Li_2SO_4 added, in $Sr(NO_3)_2$ with KNO_3 added.

RUBIDIUM BROMIDE RbBr Br

A solution containing 8.7 wt. % iodine in benzene is in equilibrium with excess solid iodine and rubidium bromide. (Foote and Fleischer, 1940)

Reaction in the system RbBr + CsF below the melting points was studied with X-rays by Link and Wood, 1940.

CH **RUBIDIUM DIPICRYLAMINATE** $Rb[(NO_2)_3C_6H_2NHC_6H_2(NO_2)_3]$

SOLUBILITY IN WATER
(Treadwell and Hepenstrick, 1949)

t°	$Rb[(NO_2)_3C_6H_2NHC_6H_2(NO_2)_3]$	
	Gms. per liter	Moles per liter
20	0.294	5.6×10^{-4}
25	.391	7.5×10^{-4}

CH **RUBIDIUM PICRATE** $Rb[C_6H_2(NO_2)_3O]$

The salt is 8% soluble in acetonitrile at 25°. (Pleskov, 1948)

Cl **RUBIDIUM CHLORIDE** RbCl

0.402 gms. RbCl are dissolved in 100 gms. of Sat. Sol.in liquid sulfur dioxide at 25°. (Shatenstein and Viktorov, 1937)

Melting points in the system RbCl - $RbNO_3$ are given by Blidin, 1941.

The reaction in the system RbCl - CsF below the melting points was studied with X-rays by Link and Wood, 1940.

ClI **RUBIDIUM DICHLOROIODIDE** $RbCl_2I$

SOLUBILITY OF RUBIDIUM DICHLOROIODIDE IN HYDROCHLORIC ACID SOLUTIONS
(Bender and Strehlow, 1948)

Moles HCl per 1000 gms. H_2O in Solvent	Results at 0°		Results at 25°	
	Gms. $RbCl_2I$ per		Gms. $RbCl_2I$ per	
	100 gms. Sat. Sol.	100 cc. Sat. Sol.	100 gms. Sat. Sol.	100 cc. Sat. Sol.
1.998	25.20	31.68	44.02	64.92
4.909	17.51	21.50	28.73	38.20
8.989	10.66	12.98	17.51	22.17
12.48	8.75	10.83	13.58	17.16

F **RUBIDIUM FLUORIDE** RbF

Melting points in the systems RbF - YF_3, RbF - LaF_3 and RbF - AlF_3 are given by Dergunov, 1948.

Reactions in the systems RbF - CsCl, RbF - CsBr, and RbF - CsI below the melting points were studied with X-rays by Link and Wood, 1940.

RUBIDIUM IODIDE RbI

SOLUBILITY OF RUBIDIUM IODIDE IN WATER

(Briggs, Conrad, Gregg, and Reed, 1941)

t°	Gms. RbI per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. RbI per 100 gms. Sat. Sol.	Solid Phase
-1.3	9.58	Ice	3.2	57.05	RbI
-3.5	20.13	"	13.9	60.20	"
-6.2	31.33	"	24.3	63.66*	"
-8.4	38.43	"	25.6	62.90	"
-8.6	39.15	"	35.6	64.70	"
-12.2	48.11	"	48.5	66.76	"
-13.0	50.0	Ice + RbI	59.4	68.61	"
-10.0	51.18	RbI	77.2	70.89	"
-2.7	54.51	"	93.0	73.01	"
0.0	55.5	"	111.5	75.05	"

*Buchanan, 1906

EQUILIBRIUM IN THE SYSTEM RUBIDIUM IODIDE - IODINE - WATER

(Briggs, Conrad, Gregg, and Reed, 1941)

Gms. per 100 gms. Sat. Sol.		Solid Phase
I	RbI	
Results at 0°		
0.0	55.5	RbI
2.6	55.9	RbI + RbI_3
2.8	54.9	RbI_3
3.7	48.5	"
5.2	38.8	"
8.4	26.1	"
8.7	24.5	"
13.4	18.7	"
15.3	18.6	RbI_3 + Iodine
12.8	15.9	Iodine
Trace	0.0	"
Results at 25°		
0.0	62.0	RbI
5.5	61.1	RbI + RbI_3
8.0	54.2	RbI_3
9.3	52.2	"
14.7	46.2	"
15.9	44.2	"
26.0	38.0	"
30.1	37.1	"
40.6	35.6	"
46.7	34.8	"
47.6	33.9	"
53.8	32.5	"
56.7	31.1	"
59.7	30.4	"
64.7	27.6	RbI_3 + Iodine
56.2	28.5	Iodine
50.0	29.1	"
45.1	28.2	"
35.4	26.2	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
I	RbI	
Results at 25° (Con.)		
26.0	23.4	Iodine
14.4	16.8	"
7.6	11.0	"
Trace	0.0	"
Results at 70°		
0.0	70.1	RbI
12.30	63.51	"
21.58	58.26	"
34.1	51.1	RbI + RbI_3
47.4	42.2	RbI_3
80.3	17.9	RbI_3 + Iodine
75.64	19.30	Iodine
69.00	20.77	"
64.07	21.76	"
63.23	22.08	"
30.82	20.97	"
21.80	17.79	"
16.95	15.29	"
9.46	10.01	"
0.2	0.0	"
Results at 90°		
0.0	72.7	RbI
44.0	46.6	RbI + RbI_3
84.0	16.0	RbI_3
87.7	12.3	Iodine
77.6	14.9	Iodine + 2 Liquids
67.31	19.24	2 Liquids
66.16	19.47	"
42.38	21.61	"
26.3	17.7	Iodine + 2 Liquids
0.3	0.0	Iodine

Invariant Points in the System

t°	Gms. per 100 gms. Sat. Sol. I	Gms. per 100 gms. Sat. Sol. RbI	Solid Phase
0	Trace	0.0	Ice + Iodine + Liquid
-13.0	0.0	50.0	Ice + RbI + Liquid
80.8	84.9	15.1	RbI_3 + Iodine + Liquid
188	59.4	40.6	RbI_3 + RbI + Liquid
98.2	0.4	0.0	Iodine + Liquid + Vapor
113	99.9	0.0	"
116.0	0.0	75.5	RbI + Liquid + Vapor
238	58.2	41.8	"
-13.9	1.7	50.1	Ice + RbI + RbI_3 + Liquid
-2.6	13.0	16.9	Ice + RbI_3 + Iodine + Liquid
98.4	21.5	15.4	Iodine + Two Liquids + Vapor
98.4	83.4	10.9	"

I

Additional polythermal data for the system are also given.

SOLUBILITY OF RUBIDIUM IODIDE IN ACETONE

(Evertz and Livingston, 1949)

t°	Gms. RbI per 100 gms. Sat. Sol.	t°	Gms. RbI per 100 gms. Sat. Sol.	t°	Gms. RbI per 100 gms. Sat. Sol.
-78.5	3.77	-2.0	1.64	25	0.72
-60	2.98	0	1.15	30	0.65
-40	2.25	20	0.79		

EQUILIBRIUM IN THE SYSTEM RUBIDIUM IODIDE - IODINE - BENZENE

(Foote and Fleischer, 1940)

Results at 6°				Results at 25°	
Gms. Iodine per 100 gms. Sat. Sol.	Solids	Gms. Iodine per 100 gms. Sat. Sol.	Solids	Gms. Iodine per 100 gms. Sat. Sol.	Solids
0.18	A + B	5.97	C	0.37	A + B
.61	B	6.92	C	0.99	B
3.71	B	6.99	C + D	6.05	B
4.08	B + C	7.17	D	8.06	B
4.24	C	7.58	D	9.16	B + C
4.49	C	7.88	D	9.68	C
4.99	C	7.95	D	9.79	C
5.34	C	8.15	D	10.04	C
5.70	C	8.53	D	10.90	C + D
5.75	C	8.71	D + E	11.61	D
				12.85	D
				13.44	D
				13.65	D
				14.20	D + E

A = RbI
B = RbI_3
C = $RbI_7 \cdot 4C_6H_6$
D = $RbI_8 \cdot 4C_6H_6$
E = I_2

EQUILIBRIUM IN THE SYSTEM RUBIDIUM IODIDE - IODINE - TOLUENE

(Foote and Fleischer, 1940) I

Results at 6°		Results at 25°	
Gms. Iodine per 100 gms. Sat. Sol.	Solid Phase	Gms. Iodine per 100 gms. Sat. Sol.	Solid Phase
0.20	$RbI + RbI_3$	0.40	$RbI + RbI_3$
0.76	RbI_3	1.83	RbI_3
1.02	"	14.90	"
7.03	"	15.07	"
10.26	$RbI_3 + I_2$	15.40	$RbI_3 + I_2$

Rubidium Iodide is 3% soluble in acetonitrile at 25°. (Pleskov, 1948)

Reaction in the system RbI - CsF below the melting points has been studied with X-rays by Link and Wood, 1940.

RUBIDIUM PERRHENATE $RbReO_4$ ReO

SOLUBILITY IN WATER

(Smith and Long, 1948)

Temperature°:	0	30	50.3
Gms. $RbReO_4$ per 100 gms. H_2O:	0.389	1.570	3.52

RHENIUM Re Re

The distribution of rhenium in the system Fe + FeS at the eutectic temperature was determined by Noddack, Noddack, and Bohnstedt, 1940.

RHODIUM Rh Rh

The distribution of rhodium in the system Fe + FeS at the eutectic temperature was determined by Noddack, Noddack and Bohnstedt, 1940.

RHODIUM AMMINE NITRITE $Rh(NH_3)_3(NO_2)_3$ NO

SOLUBILITY IN WATER

(Petkov, 1949)

Temperature°:	10	20	25
Gms. $Rh(NH_3)_3(NO_2)_3$ per 100 gms. H_2O	0.0146	0.0315	0.0394

Rn RADON Rn

Radon is listed as "Radium Emanations" in Vol. I, p. 1426.

SOLUBILITY OF RADON IN WATER

Lawrence, et al (1946) reviewed the work of von Antropoff (1910, 1919) Valentiner (1927, 1930), Estreicher (1899), and Meyer (1913) on the solubility of Radon in water and drew a smooth curve through the points given by all the authors. The agreement among the various results is not good, but those of Valentiner approximate the average curve. The data below were read from the average curve of Lawrence:

t°	β	t°	β
0	0.51	40	0.14
10	.33	50	.115
20	.23	60	.098
30	.17	70	.088

β = Bunsen adsorption coefficient: ml. gas measured at 0°, 760 mm. which dissolve in 1 ml. of solvent, when the partial pressure of the gas is 760 mm.

SOLUBILITY OF RADON IN ORGANIC SOLVENTS AT 18°

(Semenchenko and Shakparonov, 1948)

Solvent	Moles Rn per Cubic Meter of Solution	Solvent	Moles Rn per Cubic Meter of Solution	Solvent	Moles Rn per Cubic Meter of Solution
C_6H_{14}	0.6800	$(C_2H_5)_2O$	0.6190	$C_6H_5NH_2$	0.1561
C_6H_6	.5270	Cyclohexane	.7400	$(CH_3)_2CO$	.2585
$C_6H_5CH_3$	.5440	$CHCl_3$	.6195	C_2H_5OH	.2535
CS_2	.9500	$CH_3COOC_2H_5$	.3015	Glycerin	.0082
				H_2O	.0117

SOLUBILITY OF RADON IN OLIVE OIL

(Lurie, 1910)

22°	β = 0.25
37°	β = 0.19

Ru RUTHENIUM Ru

The distribution of ruthenium in the system Fe + FeS at the eutectic temperature was determined by Noddack, Noddack, and Bohnstedt, 1940.

SULFUR S

SOLUBILITY OF SULFUR IN CHLORINATED ETHANES

(Gemmellaro, 1940)

t°	Gms. S per 100 gms. $C_2H_2Cl_4$	Gms. S per 100 gms. C_2HCl_3	t°	Gms. S per 100 gms. $C_2H_2Cl_4$	Gms. S per 100 gms. C_2HCl_3
15	1.05	-	80	3.45	3.15
15.5	-	0.85	87	-	4.1*
40	1.60	1.5	90	8.15	-
60	2.15	2	100	18	-
70	2.70	2.5	110	39	-
			120	100	-

*Boiling point

Data for the solubility of sulfur in several slightly polar solvents is given by Negisi, 1940.

SOLUBILITY OF SULFUR IN RUBBER

The solubility and rate of diffusion of sulfur in natural crepe and in several synthetic rubbers was determined by Kemp, Malm, and Stiratelli, 1944 as a function of temperature and previous treatment. Data are also given by Kemp, Malm, and Winspear, 1940.

Data for the solubility of sulfur in styrene - butadiene copolymer is given by Williams, 1943.

Melting points in the system sulfur - anthracene are given by Ketelaar and Jibben, 1948.

The surface tension and density of solutions of sulfur in carbon disulfide at 12°, 17°, and 25° have been accurately determined by Kapustinsky and Golutvin, 1947.

SULFUR DIOXIDE SO_2 O

Correction to Volume I, p. 1457 "Vapor pressure of Aqueous SO_2"

The vapor pressure of a solution containing 200 gms. SO_2 per 1000 gms. H_2O at 7° is 857 mm.

SOLUBILITY OF SULFUR DIOXIDE IN WATER

The partial pressure of sulfur dioxide over its aqueous solutions has been determined by Benschlein and Simenson, 1940, Campbell and Maas, 1930, and Morgan and Maas, 1931 with results that do not agree with those of previous workers (for example those summarized by Sherwood, Vol. I, p. 1457). The data of B. and S. overlap and extend those found in the International Critical Tables and have been put into equation and nomograph form by Davis, 1941. The approximate data listed below were read from curves drawn by B. and S. and M. and M.

- Partial pressure of SO_2 cm. Hg. -

t°	Gms. SO_2 per 100 gms. of H_2O						
	1	2	4	6	8	10	15
*0	2	5	11	17.5	24	31	50
*10	3.5	7.5	17	27	37	47	73.5
*18	5	11	24.5	38	51.5	65	
20	3	11	27	43	58		
*25	6	15	32	50.5	67	84	
30	7	17	38	58	78		
40	11	25	51	77			
50	16	34	70				
60	21	45	92				
70	27	115					
80	34						
90	44						
100	55						

*Data of Morgan and Maass

FREEZING POINTS IN THE SYSTEM $SO_2 - H_2O$

(Fischer and Burger, 1943)

Wt. % SO_2	t°C	Wt. % SO_2	t°C	Wt. % SO_2	t°C
0.96	-0.1	5.80	-2.0	8.23	+0.4
1.94	-0.6	6.32	-2.1	9.66	2.2
3.53	-1.2	*6.7	-2.4	11.08	4.2
4.46	-1.5	7.40	-1.6	12.92	6.6

*Eutectic

Data for the solubility of sulfur dioxide in water at atmospheric pressure from 0° to 100° is given by Oman, 1924.

TOTAL VAPOR PRESSURES OF AQUEOUS SULFUR DIOXIDE SOLUTIONS

(Maass and Maass, 1928)

Pressures are given in cm. of mercury at 0°.

Wt. % SO_2	Cm. Hg.	Wt. % SO_2	Cm. Hg.	Wt. % SO_2	Cm. Hg.	Wt. % SO_2	Cm. Hg.
10°		16.5°		22°		25°	
4.57	24.3	4.48	31.0	4.40	37.8	6.9	66.2
8.19	45.2	8.03	57.2	7.88	69.3	22.4	246.9
11.64	67.4	11.42	84.4	11.17	102.2	27°	
14.75	87.4	14.31	111.4	14.04	132.6	4.32	44.8
18.91	124.5	18.57	151.9	18.22	178.3	7.71	81.0
19.86	128.8	19.52	156.0	19.14	186.1	10.95	118.3
23.10	154.3	22.71	188.4	22.32	222.2	13.74	152.8
						17.85	206.9
						21.86	255.6

SOLUBILITY OF SULFUR DIOXIDE IN SULFURIC ACID SOLUTIONS

(Lopatto and Savinaev, 1934)

Wt. % H_2SO_4 in Solvent	% SO_2 in SO_2 + Air Mixture	% SO_2 in Acid				
		20°	30°	40°	50°	60°
61.59	9	-	0.345	0.262	0.194	0.153
	12	-	.587	.449	.314	.250
	24	-	1.990	1.495	1.00	1.730
66.71	7.2	0.304	0.221	0.167	-	-
	17.6	.809	.560	.401	-	-
	23.8	1.172	0.734	-	-	-
	37.6	2.058	1.317	1.043	-	-
70.74	9	-	0.255	0.175	0.137	0.104
	12	-	.362	.270	.199	.162
	18	-	.522	.420	.344	.271
	24	-	.744	.542	.418	.355
73.64	9	-	.415	.327	.249	.169
	12	-	.523	.395	.270	.210
	24	-	.854	.609	.474	.371
78.04	9	-	.380	.262	.209	.146
	12	-	.455	.353	.252	.194
	18	-	.586	.439	.340	.263
	24	-	.779	.542	.452	.364

SOLUBILITY OF SULFUR DIOXIDE IN SULFURIC ACID AND OLEUM SOLUTIONS

(Miles and Carson, 1946)

The authors plotted their data and drew curves which show minima or inflections at compositions corresponding to $H_2SO_4 \cdot H_2O$, H_2SO_4, and $H_2SO_4 \cdot SO_3$, but the accuracy of the determinations seems to justify only the drawing of a smooth curve having a single minimum near 70% total SO_3 [$H_2SO_4 \cdot H_2O$]. Results are given for a partial pressure of SO_2 = 760 mm. and were read from the smooth curve.

Results at 20°		Results at 40°		Results at 60°	
Gms. SO_3 per 100 gms. $SO_3 + H_2O$	Gms. SO_2 per 100 gms. Acid	Gms. SO_3 per 100 gms. $SO_3 + H_2O$	Gms. SO_2 per 100 gms. Acid	Gms. SO_3 per 100 gms. $SO_3 + H_2O$	Gms. SO_2 per 100 gms. Acid
82	4.2	57	1.72	57	1.05
84	4.9	60	1.55	60	.90
86	6.2	65	1.45	65	.85
88	8.2	70	1.5	70	.90
90	10.5	75	1.7	75	1.00
92	15.0	80	2.1	80	1.3
93	18.0	85	2.9	85	1.7
94	21.5				
95	27.2				

Data for the solubility of sulfur dioxide in water and 0 - 95% sulfuric acid solutions from 2° to 120° is given by Kuznetsov, 1941.

The freezing points of mixtures of nitric acid and fuming sulfuric acid are given by Gelfman, 1948.

Data for the solubility of sulfur dioxide in calcium bisulfite solutions is given by White, Vivian, and Whitney (1948), Conrad and Buesch-lein (1937), and Euckell (1925). Euckell also gives data for the solubility in water, sulfuric acid, and sodium sulfate solutions from 40° to 90°.

Data for the solubility of sulfur dioxide in disodium hydrogen phosphate solutions is given by Luchinskii and Tavrovskaya, 1940.

EQUILIBRIUM IN THE SYSTEM $SO_2 - MgO - H_2O$

The amounts of free and combined SO_2 in solutions saturated with SO_2 and $MgSO_3 \cdot 6H_2O$ at 15° and 25° up to one atmosphere total pressure are given by Conrad and Brice, 1948.

O

Data for the solubility of sulfur dioxide in liquid magnesium is given by Schneider and Esch, 1940.

SOLUBILITY OF SULFUR DIOXIDE IN ETHYL ALCOHOL

(Carius, 1866)

The absolute alcohol had a density of 0.792 at 20°. These results are in reasonably good agreement with those of de Bruyn (Vol. I, p. 1462).

t°		Density of Solution	t°		Density of Solution
0	327.8	1.119	15	144.1	0.966
5	251.2	1.055	20	113.6	.940
10	190.0	1.004	25	98.3	.928

SOLUBILITY OF SULFUR DIOXIDE IN BENZENE

(Ipatieff and Monroe, 1942)

t°	Total Pressure atm. (absolute)	Gms. SO_2 per 100 gms. Benzene
26	1.20	24.7
26	1.75	37.6
27	2.40	84.8
25	2.65	125.5

SOLUBILITY OF SULFUR DIOXIDE IN ORGANIC SOLVENTS AT 20°

(Weissenberger and Hadwiger, 1927)

Solvent	Ml. SO_2 absorbed per ml. of Solvent	Solvent	Ml. SO_2 absorbed per ml. of Solvent
Cyclohexanone	22.80	20 Wt. % Camphor in m-Methylcyclohexanol	11.00
10 Wt. % Camphor in Cyclohexanone	15.20	Decahydronaphthalin	7.50
20 Wt. % Camphor in Cyclohexanone	14.70	Hydroterpine (Density = 0.883)	14.5
m-Methylcyclohexanol	16.72	Turpentine	8.3
10 Wt. % Camphor in m-Methylcyclohexanol	17.30	10 Wt. % Camphor in Tetrahydronaphthalin	6.95

SOLUBILITY OF SULFUR DIOXIDE IN SOLAR OIL (PETROLEUM)

(Avdeeva and Pitelina, 1947)

See note p. 100

t°	Gms. SO_2 per liter	Moles SO_2 per liter	t°	Gms. SO_2 per liter	Moles SO_2 per liter
10	40.60	0.635	60	14.68	0.229
14	38.10	.596	110	6.44	.105
30	23.40	.366	115	6.00	.094

O

Melting point data are given for the following:

SO_2 + Pyridine	(Hoffman and Van der Werf, 1946)
SO_2 + α-Picoline	(")
SO_2 + β- "	(")
SO_2 + γ- "	(")
SO_2 + Acetic Acid	(Scheub and McCrosky, 1944)
SO_2 + Ethylene Oxide	(Albertson and Fernelius, 1943)
SO_2 + Dioxane	(")
SO_2 + Anisole	(")
SO_2 + Acetone	(")
SO_2 + Diethylsulfide	(")
SO_2 + Methylaniline	(")
SO_2 + 2, 3 Lutidine	(Hoffman and Van der Werf, 1948)
SO_2 + 2, 4 Lutidine	(")
SO_2 + 2, 6 Lutidine	(")
SO_2 + n-Hexane	(Seyer and Gill, 1924)
SO_2 + Cetane	(Seyer and Hugget, 1924)

ANTIMONY Tri BROMIDE $SbBr_3$

Br

Melting points are given for:

$SbBr_3$ + m-Nitrophenol	(Pushin, 1948a)
$SbBr_3$ + Trinitrotoluene	(Pushin, Nikolic, et al, 1947)

ANTIMONY Tri CHLORIDE $SbCl_3$

Cl

Melting points are given for:

$SbCl_3$ + Trinitrotoluene	(Pushin, Nikolic, et al, 1947)
$SbCl_3$ + p-$CH_3C_6H_4CN$	(Pushin, Ristic, Parchomenko, and Ubovic, 1942)

ANTIMONY Tri IODIDE SbI_3

I

Melting points are given for:

SbI_3 + C_6H_5CN	(Pushin, Ristic, Parchomenko, and Ubovic, 1942)
SbI_3 + Naphthalene	(Pushin, 1948a)
SbI_3 + Nitrobenzene	(")

F ANTIMONY Tri FLUORIDE SbF_3

SOLUBILITY OF ANTIMONY TRIFLUORIDE IN ORGANIC SOLVENTS AT 25°

(Breck, Harvey, and Haendler, 1949)

Solvent	Gms. SbF_3 per 100 ml. Sat. Sol.	Solvent	Gms. SbF_3 per 100 ml. Sat. Sol.
Benzene	5.5×10^{-4}	Methanol	133
n-Heptane	1.6×10^{-3}	1 - Propanol	34.3
1, 4 Dioxane	1.11	Methyl Ethyl Ketone	8.0
Di - n - Butyl Ether	5×10^{-2}	Acetone	55.3
Chlorobenzene	5.0×10^{-4}	Nitrobenzene	5.6×10^{-2}

H STIBINE SbH_3

At room temperature 1 volume of water dissolves 1/5 volume of SbH_3.

At room temperature 1 volume of alcohol dissolves 15 volumes of SbH_3.

At 0° 1 volume of carbon disulfide dissolves at least 250 volumes of SbH_3. Stock and Guttmann, 1904.

S ANTIMONY Tri SULFIDE Sb_2S_3

Kapustinsky (1940) calculated the solubility product at 25° on the basis of thermochemical data to be 2.9×10^{-59}. The calculated solubility in aqueous solutions is thus:

pH	3	5	7	9	11
Moles Sb_2S_3 per liter	3.3×10^{-2}	1.3×10^{-4}	8.2×10^{-7}	3.5×10^{-8}	2.2×10^{-9}

OH SCANDIUM HYDROXIDE $Sc(OH)_3$

Oka, 1940 found the solubility of scandium hydroxide in water to be 1.3×10^{-8} moles per liter.

Se SELENIUM Se

The surface tension and density of solutions of selenium and sulfur in carbon disulfide were accurately determined by Kapustinsky and Golutvin, 1947.

Br

SILICON TETRABROMIDE $SiBr_4$

MELTING POINTS OF SILICON TETRABROMIDE - DIOXANE SOLUTIONS
(Kennard and McCusker, 1948)

Mole % Dioxane	Melting Point	Solid Phase	Mole % Dioxane	Melting Point	Solid Phase
0.0	5.4	S	31.1	-11.1	S*
0.0	2.3	S*	39.5	-11.4	S + C
4.5	2.9	S	39	-13.5	S* + C
8.4	1.2	S	44.5	-8.6	C
8.4	-2.0	S*	50.6	-6.0	C
10.0	+0.4	S	56.4	-4.0	C
10.0	-3.2	S*	61.2	-2.7	C
12.5	-0.8	S	66.9	-1.1	C
12.5	-4.2	S*	70.6	+0.1	C + D
16.3	-2.2	S	75.5	1.7	D
16.3	-5.8	S*	80.8	3.6	D
19.8	-3.9	S	86.4	6.9	D
19.8	-7.1	S*	90.9	7.5	D
27.0	-6.9	S	96.6	10.0	D
31.1	-8.2	S	100.0	11.8	D

* = Metastable S = $SiBr_4$ C = $SiBr_4 \cdot 4(CH_2)_4O_2$ D = $(CH_2)_4O_2$

Densities, dielectric constants, and polarizabilities of dilute silicon tetrabromide - dioxane solutions and silicon tetrabromide - carbon tetrachloride solutions are also given by Kennard and McCusker, 1948.

Cl

SILICON TETRACHLORIDE $SiCl_4$

Melting point data are given for the following systems:

$SiCl_4$ + Dioxane (Kennard and McCusker, 1948)
$SiCl_4$ + Anisole (Sisler, et al, 1948) (Sisler and Cory, 1947)
$SiCl_4$ + Phenetole (Sisler, et al, 1948)
$SiCl_4$ + Methyl-m-Cresyl Ether (Sisler, et al, 1948)
$SiCl_4$ + Diphenyl Ether (Sisler and Cory, 1947)
$SiCl_4$ + Diethyl Ether (Sisler and Mattair, 1948)(Sisler, Batey, Pfahler, and Mattier, 1948)
$SiCl_4$ + Tetrahydrofuran (Sisler, Batey, Pfahler, and Mattier, 1948)
$SiCl_4$ + Azobenzene (Pushin, 1948a)
$SiCl_4$ + Naphthalene (Pushin, 1948a)

Cl

SILICON Methyl CHLORIDES $SiCl(CH_3)_3$ $SiCl_2(CH_3)_2$ $SiCl_3(CH_3)$

Melting points in the systems $SiCl_4$ - diethyl ether, $SiCl(CH_3)_3$ - diethyl ether, $SiCl_2(CH_3)_2$ - diethyl ether and $SiCl_3(CH_3)$ - diethyl ether are given by Sisler and Mattair, 1948.

O SILICON DIOXIDE SiO_2

SOLUBILITY OF QUARTZ IN ALKALINE SOLUTIONS

(Friedman, 1948) (Tuttle and Friedman, 1948)

Gms. SiO_2 per liter of Aqueous NaOH or Na_2CO_3 Solution

Solvent % Na_2O	300°		350°		400°		450°	
	NaOH	Na_2CO_3	NaOH	Na_2CO_3	NaOH	Na_2CO_3	NaOH	Na_2CO_3
1	20	5	25	13	35	22	35	24
5	135	28	152	50	155	90	163	124
15	514	43	515	60	560	105	560	285

Weighed amounts of pure quartz and sodium carbonate were added to 10 ml. of water in a pressure bomb and rocked up to 150 hours at each temperature. The data for NaOH are from Tuttle and Friedman.

SOLUBILITY OF SILICA IN AQUEOUS SOLUTIONS

(Correns, 1941)

pH of Solution	0	3	5	6	11
Millimoles SiO_2 dissolved in 1 liter after 8 months	1.65	0.65	1.81	3.63	6.3

Data for the solubility of SiO_2 in NH_4F solutions is given by Dixon, 1946.

Data for the solubility of silica in steam at high pressures and temperatures is given by Gillingham, 1948. In general the solubility increases with increasing pressure and with decreasing temperature, and considerable attention is given to the crystallization of various minerals in nature.

Sm SAMARIUM Sm

Data for the solubility of samarium compounds are found on pages 1465-1468 in Volume I.

NO SAMARIUM NITRATE $Sm(NO_3)_3$

DISTRIBUTION OF SAMARIUM NITRATE BETWEEN WATER AND n-HEXYL ALCOHOL AT 25°

(Templeton, 1949)

The salt was prepared from "pure" samarium oxide and probably contained excess nitric acid.

Wt. % Sm_2O_3 in	
Aqueous Phase	Alcohol Phase
30.2	5.88
28.0	3.33
25.1	1.37
22.7	0.64
20.6	.38
18.6	.20

SeO

SAMARIUM SELENATE $Sm_2(SeO_4)_3 \cdot 8H_2O$

SOLUBILITY OF SAMARIUM SELENATE IN WATER
(Friend, 1941)

The solid phase is $Sm_2(SeO_4)_3 \cdot 8H_2O$ throughout.

t°	Gms. $Sm_2(SeO_4)_3$ per 100 gms. Sat. Sol.	t°	Gms. $Sm_2(SeO_4)_3$ per 100 gms. Sat. Sol.
16.6	33.60	50.0	22.15
25.0	30.21	55.0	21.13
35.2	26.42	64.6	18.62
45.0	23.56	80	14.00

WO

SAMARIUM TUNGSTATE $Sm_2(WO_4)_3$

SOLUBILITY OF SAMARIUM TUNGSTATE IN WATER
(Vickery, 1949)

	Gms. $Sm_2(WO_4)_3$ per 100 ml.	
	20°	100°
Unignited	0.025	0.032
Ignited	0.003	0.004

Sn

TIN Sn

Melting point data for the system Sn + SnS are given by Anderson and Ridge, 1943.

Br

TIN Tetra BROMIDE $SnBr_4$

Bond and Belton, 1945 reinvestigated the system $SnBr_4 - SO_2$ (See Vol. I, p. 1489) and found the compound $2SnBr_4 \cdot SO_2$. This is identical in properties and composition with the heavy liquid layer found previously.

Melting point data are given for:

$SnBr_4$ + o-$CH_3C_6H_4CN$ (Pushin, Ristic, Parchomenko, and Ubovic, 1942)
$SnBr_4$ + Trinitrotoluene (Pushin, et al, 1947)

MELTING POINTS IN SYSTEMS OF STANNIC BROMIDE WITH ORGANIC COMPOUNDS**

(Kurnakov and Woskressenskaya, 1937)						(Kurnakov and Sternin, 1936)		
With $(COOCH_3)_2$			With $(CH_2COOCH_3)_2$			With $CH_3COOC_2H_5$		
Mole % $SnBr_4$	t°	Solid Phase	Mole % $SnBr_4$	t°	Solid Phase	Mole % $SnBr_4$	t°	Solid Phase
0	54	A	0	18.4	C	0	-83.6	E
10	50.2	A	5	17.0	C	1.41	-91.5	E + F
20-85	48	A*	9	15.6	C + D	5.00	-75.25	F
95	30.2	A	10	21.8	D	10.00	-54.50	F
97	28.7	A + B	20	32.2	D	20.00	-18.0	F
100	29.5	B	30	35.0	D	29.23	-8.0	F
			45	36.6	D	31.80	-7.0	F + G
20	60.1	2L	50	36.8	D	32.00	-3.0	G
30	72	2L	60	36.3	D	40.00	+2.5	G
40	78	2L	70	35.0	D	50.00	5.7	G
50	80	2L	80	32.5	D	57.50	3.8	G
60	78	2L	90	27.7	D	58.50	2.8	G + B
70	72	2L	92	25.5	D + B	75.00	15.2	B
80	60.1	2L	100	29.5	B	100.00	29.9	B

A = $(COOCH_3)_2$ B = $SnBr_4$ C = $(CH_2COOCH_3)_2$ D = $SnBr_4 \cdot (CH_2COOCH_3)_2$
E = $CH_3COOC_2H_5$ F = $SnBr_4 \cdot 3CH_3COOC_2H_5$ G = $SnBr_4 \cdot CH_3COOC_2H_5$

A* = $(COOCH_3)_2$ at this temperature the solid phase melts to form two immiscible liquids which have an upper consolute point at 80°. The composition of the conjugate pairs are listed beneath the compositions of solid - liquid equilibrium and are marked "2L".

**The densities, viscosities, and conductivities of these systems were also determined.

The densities and viscosities of solutions of $SnBr_4$ in the following solvents at various temperatures were determined by:

(Kurnakov and Sternin, 1936)			(Kurnakov and Woskressenskaya, 1937)	
Ethyl Formate	Methyl Oxalate		$CO(OCH_3)_2$	C_2H_5OH
Ethyl Ether	Ethyl Malonate		$CO(OC_2H_5)_2$	C_6H_5OH
Methyl Acetate	Ethyl Ester of Ethyl Malonic Acid		$B(OCH_3)_3$	$(C_2H_5)_2S$
	Methyl " " " " "		$B(OC_2H_5)_3$	

CH **TIN CUPFERRATE** $Sn(C_6H_5N(NO)O)_4$

The solubility product is 7.5×10^{-35}. (Pyatnitski, 1946)

TIN Tetra CHLORIDE $SnCl_4$

MELTING POINTS IN SYSTEMS OF STANNIC CHLORIDE AND NITRILES

(Pushin, Ristic, Parchomenko, and Ubovic, 1942)

Mole % Propio-nitrile	t°	Mole % Benzo-nitrile	t°	Mole % o-Tolui-nitrile	t°	Mole % m-Tolui-nitrile	t°
0	-33	0	-33	0	-33	0	-33
11	+23	13	+54.5	10.5	+36	8.5	+14
23.5	35	20	66	20	47.5	18	42
34.5	45	31	81	30.5	56	30	62
44	54	40	91.5	41	63	40	75.5
56	66	46.5	98	50.5	67	50	86.5
60	71	53.5	104	60	70	60	94.5
66.6	76.5	66.6	109	66.7	73	66.6	97
70	73.5	76.5	104	69.5	71.5	70	95
74	66	80	100	79.5	54	80	86
83	31	89	80	84	41	88.5	64.5
100	-104	100	-12.5	100	-14		

MELTING POINTS IN SYSTEMS OF STANNIC CHLORIDE WITH ORGANIC COMPOUNDS

(Kurnakov and Woskressenskaya, 1937)

With $(COOCH_3)_2$			With $(COOC_2H_5)_2$			With $CH_2(COOC_2H_5)_2$		
Mole % $SnCl_4$	t°	Solid Phase	Mole % $SnCl_4$	t°	Solid Phase	Mole % $SnCl_4$	t°	Solid Phase
0	54.2	A	0	-41	D	0	-49.8	F
10	49.2	A	10	30.2	E	20	-2	G
20	42.5	A + B	20	58.5	E	30	55.8	G
25	63.2	B	30	69.1	E	40	98	G
30	73.2	B	40	78.6	E	45	112.1	G
40	86.8	B	47	81.9	E	48	115.8	G
50	90.6	B	50	83.6	E	50	116.8	G
52	89.8	B	52	82.6	E	52	110	G*
55 - 92	88.2	B*	60 - 97	80.3	E*	60 - 95	110	G**
95	72	B	100	-30	C	100	-30	C
100	-30	C						

With $(CH_2COOC_2H_5)_2$								
0	-20.8	H	40	71.8	I	75	57	I
10	+1.0	I	50	96.4	I	80	49.5	I
25	37.2	I	52	94.2	I	90	36.3	I
30	44.6	I	60	79.7	I	100	-30	C
33.3	52.1	I	66.6	68.2	I			

With $CO(OC_2H_5)_2$								
10	30.1	J	35	46.5	J	50	53.1	K
20	42.0	J	37	42.1	J + K	60	50.0	K
30	47.4	J	40	49.0	K	75	33.5	K
33.3	47.9	J	45	51.5	K	100	-30	C

A = $(COOCH_3)_2$ B = $SnCl_4 \cdot (COOCH_3)_2$ C = $SnCl_4$ D = $(COOC_2H_5)_2$
E = $SnCl_4 \cdot (COOC_2H_5)_2$ E* = $SnCl_4 \cdot (COOC_2H_5)_2$ + 2 liquids with upper critical temperature = 125° F = $CH_2(COOC_2H_5)_2$ G = $SnCl_4 \cdot CH_2(COOC_2H_5)_2$
G* = $SnCl_4 \cdot CH_2(COOC_2H_5)_2$ + 2 liquids with upper critical temperature = 115°
G** = $SnCl_4 \cdot CH_2(COOC_2H_5)_2$ + 2 liquids with upper crit. sol. temp. = 125°
H = $(CH_2COOC_2H_5)_2$ I = $SnCl_4 \cdot (CH_2COOC_2H_5)_2$ J = $SnCl_4 \cdot 2CO(OC_2H_5)_2$
K = $SnCl_4 \cdot CO(OC_2H_5)_2$

Cl The densities and viscosities in the systems: $SnCl_4 - CO(OC_2H_5)_2$, $SnCl_4 - CO(OC_2H_5)_2$, $SnCl_4 - B(OCH_3)_3$, and $SnCl_4 - B(OC_2H_5)_3$ are given by Kurnakov and Woskressenskaya, 1937a.

Melting point data are given for the following:

$SnCl_4$ + Diphenylether - Sisler and Cory, 1947
$SnCl_4$ + Anisole - Sisler and Cory, 1947; Sisler et al, 1948
$SnCl_4$ + o-Nitroanisole - Pushin, 1948a
$SnCl_4$ + Azobenzene - Pushin, 1948a
$SnCl_4$ + Trinitro Toluene - Pushin, et al, 1947
$SnCl_4$ + Methyl-m-Cresyl Ether - Sisler, et al, 1948
$SnCl_4$ + Phenetole - Sisler, et al, 1948

I STANNIC IODIDE SnI_4

Data for the solubility of stannic iodide in several slightly polar solvents is given by Negisi, 1940.

O STANNOUS OXIDE SnO

SOLUBILITY OF STANNOUS OXIDE IN HYDROCHLORIC ACID AND SODIUM HYDROXIDE SOLUTIONS AT 25°

(Garrett and Heiks, 1941)

Results in NaOH Solutions				Results in HCl Solutions	
Initial Moles NaOH per 1000 gms. H_2O	Moles SnO per 1000 gms. H_2O	Initial Moles NaOH per 1000 gms. H_2O	Moles SnO per 1000 gms. H_2O	Initial Moles HCl per 1000 gms. H_2O	Moles SnO per 1000 gms. H_2O
0.005	0.00065	0.060	0.00732	0.000	0.0000050
.010	.00128	.070	.00843	.005	.00175
.015	.00193	.080	.00948	.010	.00390
.020	.00256	.085	.00998	.015	.00600
.025	.00319	.100	.01200	.020	.00815
.030	.00381	.200	.0236	.030	.01245
.035	.00442	.300	.0346	.040	.01680
.040	.00502	.400	.0443		
.050	.00618				

SOLUBILITY OF STANNOUS OXIDE IN PERCHLORIC ACID SOLUTIONS AT 25°

(Gorman and Leighton, 1942)

The results are nearly identical with those of Garrett and Heiks (above) and indicate that tin does not form complex ions with Cl^-, and that the increased solubility is a function of H^+ only.

Initial Moles $HClO_4$ per liter	Moles SnO per liter	Initial Moles $HClO_4$ per liter	Moles SnO per liter	Initial Moles $HClO_4$ per liter	Moles SnO per liter
0.0113	0.00318	0.0433	0.0179	0.0866	0.0353
.0186	.00890	.0449	.0176	.0870	.0379
.0254	.0124	.0590	.0257	.1125	.0475
.0311	.0126	.0665	.0277		
.0343	.0149	.0823	.0353		

OH

STANNOUS HYDROXIDE $Sn(OH)_2$

Oka, 1940 found the solubility in water to be 2.0×10^{-9} moles per liter.

S

STANNOUS SULFIDE SnS

Kapustinsky, 1940 calculated the solubility product of stannous sulfide from thermochemical data to be 1.0×10^{-27}. The calculated solubility in various solutions are:

pH	3	5	7	9	11
Moles per liter	9.6×10^{-7}	9.7×10^{-9}	1.4×10^{-10}	1.0×10^{-11}	1.0×10^{-12}

Sr

STRONTIUM Sr

Melting point diagrams are drawn for the systems Sr - $SrBr_2$ and Sr - SrI_2 by Cubicciotti and Thurmond, 1949. About 20 - 25% of the metal dissolves in each salt, and there is a large liquid immiscibility gap in each system above 750°.

AsO

STRONTIUM ARSENATES $Sr_2H_2(AsO_4)_2$ $Sr_3(AsO_4)_2$

SOLUBILITY OF EACH IN WATER AT 17°
(Guerin and Michel, 1942)

0.45 gms of $Sr_2H_2(AsO_4)_2$ are dissolved in 100 gms. of saturated solution. The solid phase is either the di- or trihydrate.

0.027 gms. of $Sr_3(AsO_4)_2$ are dissolved in 100 gms. of saturated solution. The solid phase is $Sr_3(AsO_4)_2 \cdot 17H_2O$.

Br

STRONTIUM BROMIDE $SrBr_2$

SOLUBILITY OF STRONTIUM BROMIDE IN WATER ABOVE 100°
(Benrath, 1941)

t°	Gms. $SrBr_2$ per 100 gms. Sat. Sol.	Solid	t°	Gms. $SrBr_2$ per 100 gms. Sat. Sol.	Solid	t°	Gms. $SrBr_2$ per 100 gms. Sat. Sol.	Solid
104	69.4	A	262	78.7	A	338	91.0	A
154	71.9	A	291	81.6	A	342	92.0	A
176	73.0	A	303	82.7	A	345	92.4	A + B
212	75.1	A	319	84.4	A	366	93.3	B
224	76.2	A	331	89.0	A	383	94.0	B
249	78.2	A	335	90.0	A			

A = $SrBr_2 \cdot H_2O$ B = $SrBr_2$

Cl STRONTIUM CHLORIDE $SrCl_2$

SOLUBILITY OF STRONTIUM CHLORIDE IN WATER ABOVE 100°
(Benrath, 1941)

t°	Gms. $SrCl_2$ per 100 gms. Sat. Sol.	Solid Phase	t°	Gms. $SrCl_2$ per 100 gms. Sat. Sol.	Solid Phase
124	53.9	$SrCl_2 \cdot 2H_2O$	233	67.1	$SrCl_2 \cdot H_2O$
131	54.1	"	265	69.7	"
137	55.0	"	293	73.9	"
141	55.5	"	312	76.2	"
155	56.9	"	318	78.0	"
166	58.3	"	320	78.5	$SrCl_2 \cdot H_2O + SrCl_2$
184	60.2	"	340	79.0	$SrCl_2$
200	62.3	"	382	80.0	"
230	66.6	$SrCl_2 \cdot 2H_2O + SrCl_2 \cdot H_2O$	412	81.0	"

SOLUBILITY OF STRONTIUM CHLORIDE IN ORGANIC SOLVENTS AT 25°
(Isbin and Kobe, 1945)

Solvent:	Monoethanolamine	Ethylenediamine	Ethylene Glycol
Gms. $SrCl_2$ per 100 gms. Sat. Sol.	19.5	0.00	36.4

Melting points in the system $SrCl_2 - SrF_2$ have been determined by Bergman and Bukalova, 1949.

CrO STRONTIUM CHROMATE $SrCrO_4$

SOLUBILITY OF STRONTIUM CHROMATE IN ETHYL ALCOHOL SOLUTIONS
(Davis, 1942)

Solutions rotated with solid strontium chromate did not become saturated for more than a year, and the determinations are complicated by the slow hydration of the solid (to form a mono- or dihydrate). Some reduction of the chromate by alcohol took place upon standing for long periods of time. The lower results of previous authors (See for example, Vol. I, p. 1512) are probably the result of unsaturation. Results below are in grams $SrCrO_4$ per 100 gms. saturated solution.

Wt. % C_2H_5OH	(Approx. Volume %).	25°	50°	75°
0.0	0	0.096	0.090	0.080
19.7	25	.011	.012	.008
41.8	50	.0004	.0009	.0003
92.5	95	~ .00005	< .00005	< .00005

I STRONTIUM IODIDE SrI_2

0.14 gms. of strontium iodide are contained in 100 gms. of a saturated solution in liquid sulfur dioxide at 25°. (Shatenstein and Viktorov, 1937)

STRONTIUM NITRATE $Sr(NO_3)_2$ NO

SOLUBILITY IN WATER ABOVE 100°
(Benrath, 1942)

t°	Gms. $Sr(NO_3)_2$ per 100 gms. Sat. Sol.	t°	Gms. $Sr(NO_3)_2$ per 100 gms. Sat. Sol.
179	55	370	75
225	60	425	80
265	65	475	85
312	70		

100 grams of a saturated solution of strontium nitrate in furfural contain 0.2 gms. $Sr(NO_3)_2 \cdot 4H_2O$ at 25°. (Trimble, 1941)

STRONTIUM HYDROXIDE $Sr(OH)_2$ OH

Oka, 1940 found the solubility to be 0.066 moles per liter by means of potentiometric titration.

STRONTIUM SULFATE $SrSO_4$ SO

Strontium sulfate is 23 times as soluble in 3 N $NaNO_3$ solution as in pure water. (Belfiori, 1940)

STRONTIUM SELENATE $SrSeO_4$ SeO

0.1361 gms. $SrSeO_4$ dissolve in 100 ml. of water at 10° (Dolique, 1943)

STRONTIUM TUNGSTATE $SrWO_4$ WO

0.0284 gms. $SrWO_4$ are dissolved in one liter of saturated solution in water at 25°. (Berkem, 1943)

TANTALUM CARBIDE TaC C

X-ray analysis of the systems TaC - TiC and TaC - ZnC show continuous solid solutions. (Kovalskii and Umanskii, 1946)

Data for the system TaC - C are given by Ellinger, 1942.

TANTALUM CHLORIDE $TaCl_5$ Cl

SOLUBILITY OF TANTALUM CHLORIDE IN TITANIUM CHLORIDE
(Tarasenkov and Komandin 1940)

Temperature°	25	50	100
Gms. $TaCl_5$ per 100 gms. $TaCl_5 + TiCl_4$:	14.3	27.1	33.9

SOLUBILITY OF TANTALUM CHLORIDE IN ORGANIC SOLVENTS

(Namoradze and Zvjagincev, 1939)

Cl

Solvent	t°	Gms. $TaCl_5$ per 100 ml. Sat. Sol.	Solvent	t°	Gms. $TaCl_5$ per 100 ml. Sat. Sol.
CCl_4	20	0.838	$C_6H_5NO_2$	20	5.576
"	30	1.249	"	40	5.684
"	38	1.556	$(CH_2)_2(NH_2)_2$	20	1.336
CS_2	0	1.285	C_2H_5Br	0	11.14*
"	14	2.639	"	20	17.43
"	20	3.118	$CHCl_3$	20	5.739**
"	25	3.744			

*When a solution saturated at 20° was cooled to 0° and held there for 12 hours, the saturated solution had the same composition as at 20° (17.42).

**$TaCl_5$ forms colloidal solutions with $CHCl_3$ which yield gels upon cooling. A much longer time was needed to approach "saturation" in this solvent than in the others. The figure given is the result after 50 hours, but may not represent fine equilibrium.

Br **TANTALUM BROMIDE $TaBr_5$**

SOLUBILITY OF TANTALUM BROMIDE IN ORGANIC SOLVENTS

(Namoradze and Zvjagincev, 1939)

In CCl_4		In C_2H_5Br	
20°	0.392 gms. per 100 ml. Sat. Sol.	0°	0.256 gms. per 100 ml. Sat. Sol.
30°	1.465 " " " " " "	20°	.390 " " " " " "
		25°	.428 " " " " " "

THORIUM EMANATIONS

A complete list of references for the solubility of thorium emanations in various solvents is given by Markham and Kobe, 1941b.

THORIUM IODATE $Th(IO_3)_4$

At 25°, 0.203 gms. are dissolved in one liter of a saturated solution in water. (Spacu and Spacu, 1948)

NO **THORIUM NITRATE $Th(NO_3)_4$**

DISTRIBUTION OF THORIUM NITRATE BETWEEN WATER AND ORGANIC SOLVENTS AT 25°

(Rothschild, Templeton, and Hall, 1948)

Because of the small temperature coefficient of solubility of thorium nitrate, the determinations were made at "room temperature", and no significant errors were introduced.

Data of Rothschild, Templeton, and Hall, 1948

% ThO_2	
Organic Phase	Aqueous Phase
Methyl-n-Hexyl Ketone	
9.40	32.50
6.18	31.31
2.54	29.41
1.70	28.68
0.83	27.54
.53	26.74
.34	25.87
.17	24.78
.08	23.61
Methyl-n-Hexyl Ketone + 0.5 N HNO_3	
10.34	31.97
8.02	31.08
5.65	30.16
3.36	29.03
1.90	27.86
0.90	25.64
Methyl-n-Hexyl Ketone + 1.0 N HNO_3	
5.68	30.15
4.03	28.87
2.70	27.89
1.65	26.74
0.91	25.67
.55	24.48

Systems containing HNO_3 were found to decompose somewhat upon standing, and several determinations were also made after 2 to 4 weeks had elapsed.

% ThO_2	
Organic Phase	Aqueous Phase
Methyl-n-Amyl Ketone	
12.65	31.99
8.85	30.59
4.48	28.92
2.31	27.58
1.15	26.31
0.58	24.77
Isoamyl Alcohol	
13.97	31.21
10.87	29.65
7.46	27.83
5.62	26.88
3.60	25.54
2.31	24.13
Methyl-n-Hexyl Ketone + 5.0 N HNO_3	
7.88	30.23
3.51	29.44
2.34	28.10
1.80	27.14
0.38	26.18
4.82	25.95
1.16	25.86
0.63	23.73
.34	22.53

% ThO_2	
Organic Phase	Aqueous Phase
Methyl Isobutyl Ketone	
14.07	31.12
10.21	29.70
5.99	28.42
2.98	27.14
2.06	26.52
1.15	25.55
n-Hexyl Alcohol	
13.78	32.06
11.17	30.04
7.82	28.69
4.53	26.95
2.91	25.69
1.69	24.16
n-Hexyl Alcohol + 1.0 N HNO_3	
10.37	29.87
8.58	28.77
6.79	27.68
5.48	26.76
4.40	26.05
3.29	25.16
n-Hexyl Alcohol + 5.0 N HNO_3	
8.20	27.53
6.76	26.74
6.65	25.97
4.74	25.07
2.36	23.95
1.81	22.53

DISTRIBUTION OF THORIUM NITRATE BETWEEN ESTERS AND WATER AT 25°

(Templeton, Rothschild, and Hall, 1949)

"Practical" Grade Esters were Used

Total Composition ml.			% ThO_2 in	
Ester	Water	Saturated $Th(NO_3)_4$ Solution	Ester Phase	Water Phase
With Ethyl Butyrate				
3.0	0.0	3.0	4.76	34.31
3.0	0.2	2.8	3.74	33.41
3.0	0.4	2.6	1.95	32.08
3.0	0.6	2.4	0.81	31.02
3.0	0.8	2.2	0.23	29.68
3.0	1.0	2.0	0.07	28.81

Data of Templeton, Rothschild, and Hall, 1949 (Con.)

With Ethyl Acetate

Total Composition ml.			After 24 hrs. Agitation	+ 24 hrs. Standing	+ 24 hrs. Additional Agitation	+ 60 Days Standing
Ester	Water	Saturated $Th(NO_3)_4$ Solution				
3.0	0.0	3.0	Miscible	Miscible	Miscible	Miscible
3.0	0.2	2.8	"	"	"	"
3.0	0.4	2.6	Indistinct Separation	Indistinct Separation	"	"
3.0	0.6	2.4	"	"	"	"
3.0	0.8	2.2	Two Phases	"	"	"
3.0	1.0	2.0	"	Two Phases	"	"

NO

THE SOLUBILITY OF THORIUM NITRATE IN ORGANIC SOLVENTS AT 25°

(Templeton and Hall, 1947)

$Th(NO_3)_4 \cdot 4H_2O$ was shaken with each solvent, which was of "practical" grade or better, for 5 days. Samples were evaporated in platinum crucibles and the residues ignited to ThO_2.

Solvent	Gms. $Th(NO_3)_4$ per 100 gms. Sat. Sol.	Solvent	Gms. $Th(NO_3)_4$ per 100 gms. Sat. Sol.
Diisopropyl Ketone	20.8	Acetone	59.3
Acetophenone	37.06	Methyl Ethyl Ketone	55.7
Propiophenone	18.9	Ethanol (absolute)	55.6
Methyl Isobutyl Ketone	42.20	Ethanol 95%	56.0
Methyl n-Amyl Ketone	36.68	Methanol	65.7
Methyl n-Hexyl Ketone	31.06	Ethylene Chlorohydrin	44.4
Isoamyl Alcohol	37.8	n-Propanol	47.0
n-Hexyl Alcohol	33.4	Allyl Alcohol	45.8
n-Butyl Alcohol	44.6	Isopropyl Alcohol	44.0
Iso-Butyl Alcohol	39.9	Benzyl Alcohol	20.9
Cyclohexanol	35.9	Diether Ether	42.8
Dioxane	42.9	Di-n-Butyl Ether	2.69
Chloroform	0.01	Diisoamyl Ether	1.12
Carbon Tetrachloride	.05	Petroleum Ether	.03
Methyl Chloroform	.01	Toluene	.02
Trichloromethylene	.02	Nitrobenzene	.02
Ethylene Dichloride	.05	Aniline	.01
Ethyl Bromide	.02	Dimethylaniline	.07
Chlorobenzene	.03	Piperidine	.01
Turpentine	.04	o-Toluidine	.09
		m-Cresol	.10

The following values are the highest observed solubilities in solvents which formed very viscous solutions and do not represent true equilibrium.

Ethyl Formate	32.5	Ethylene Glycol	44.4
Methyl Acetate	50	Diethylene Glycol	47.3
Ethyl Acetate	43.4	Hexamethylene Glycol	13.5
Ethyl Propionate	67.1	Glycerol	45.6
Ethyl Butyrate	56.9	Ethylene Glycol Monomethyl Ether	59.2
Ethyl Caproate	28.6	Ethylene Glycol Monoethyl Ether	54.6
Ethyl Benzoate	6.3	Cyclohexanone	28.5
Ethyl Phenylacetate	18.42	Diethyl Carbonate	8.88
Ethyl Acrylate	12.6	Isoquinoline	10.5
Methyl Salicylate	2.4		

10 ml. of a saturated solution of thorium nitrate in ether at 20° contain 367 mg. ThO_2. (Wells, 1930)

THORIUM HYDROXIDE $Th(OH)_4$ OH

Oka, 1940 found the solubility of thorium hydroxide in water to be 3.6×10^{-10} moles per liter by potentiometric titration.

THORIUM PHOSPHATE $Th_3(PO_4)_4$ PO

Thorium phosphate is 24% soluble in 10% H_2SO_4. (Atanasiv and Babor, 1938)

THORIUM PYROPHOSPHATE ThP_2O_7 PO

SOLUBILITY IN DILUTE HYDROCHLORIC ACID SOLUTIONS AT 20°

(Moeller and Schweitzer, 1948)

Radioactive $P_2O_7^{-4}$ was added to an excess of Th^{+4} and the precipitated ThP_2O_7 was washed and dried. Samples were shaken with acid for 36 hours and then filtered off. The radioactive count in solution was taken as a measure of the solubility. The data below were read from the curve given by the authors.

Normality of HCl:	0.10	0.20	0.30
Moles ThP_2O_7 per liter:	2.2×10^{-5}	3.5×10^{-5}	5.0×10^{-5}

TITANIUM Tetra CHLORIDE $TiCl_4$ Cl

Melting point data are given for the following systems:

$TiCl_4$ + Naphthalene	Pushin, 1948a
$TiCl_4$ + Propionitrile	Pushin, Ristic, Parchmenko, and Ubovic, 1942
$TiCl_4$ + Benzonitrile	" " " " " "
$TiCl_4$ + p-Tolunitrile	" " " " " "
$TiCl_4$ + Trinitro Toluene	Pushin, et al, 1947
$TiCl_4$ + Nitrobenzene	Pushin, Nikolic, Radojein, and Voroponova, 1942
$TiCl_4$ + Chlorobenzene	" " " " " "
$TiCl_4$ + o-Nitrotoluene	" " " " " "
$TiCl_4$ + Bromobenzene	" " " " " "
$TiCl_4$ + 1, 3, 4-Nitroxylol	" " " " " "
$TiCl_4$ + m-Dinitrobenzene	" " " " " "
$TiCl_4$ + m-Dinitrotoluene	" " " " " "
$TiCl_4$ + Trinitrotoluene	" " " " " "

O TITANIUM DIOXIDE TiO_2

EQUILIBRIUM IN THE SYSTEM TITANIUM DIOXIDE - SULFURIC ACID - WATER AT 25°

(Reinders and Kies, 1940)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
H_2SO_4	TiO_2		H_2SO_4	TiO_2	
10.2	0.54	$TiO_2 \cdot nH_2O$	38.1	3.1	$TiO_2 \cdot nH_2O + TiO_2 \cdot SO_3 \cdot 2H_2O$
19.2	0.44	"	41.4	2.09	$TiO_2 \cdot SO_3 \cdot 2H_2O$
34.4	2.26	"	44.6	0.90	"
32.6	26.7*	$TiO_2 \cdot SO_3 \cdot 2H_2O$	50.1	.09	"
32.6	22.9*	"	61.1	.04	"
32.4	12.6*	"	70.2	.57	"
33.9	8.6*	"	77.4	5.1	"
			78.3	10.4	"

* = Metastable

The system was studied at 100° by Sagawa (quoted by Reinders and Kies), 1936 who found the stable solid phases to be $TiO_2 \cdot nH_2O$, $TiO_2 \cdot SO_3 \cdot H_2O$, $2TiO_2 \cdot 3SO_3 \cdot 5H_2O$, $TiO_2 \cdot 4SO_3 \cdot 4.5H_2O$, and $TiO_2 \cdot 4SO_3 \cdot 2H_2O$. The saturated solution in equilibrium with $TiO_2 \cdot nH_2O$ and $TiO_2 \cdot SO_3 \cdot H_2O$ contains 0.32% TiO_2 and 41.9% H_2SO_4.

Br THALLIUM BROMIDE TlBr

SOLUBILITY OF THALLIUM BROMIDE IN AQUEOUS SALT SOLUTIONS AT 20°

(Sirucek and Viktorin, 1939)

- Moles TlBr per 1000 gms. of Water x 10^3 -

Mole Salt per 1000 gms. of Water	$NaNO_3$	$Ba(NO_3)_2$	K_2SO_4	$Mg.(C_6H_5SO_3)_2$
0.0	1.6465	1.644*	-	-
.002	-	-	1.719	-
.0025	1.685	-	-	1.726
.005	1.717	1.788	-	1.775
.01	1.755	1.868	1.874	1.847
.02	1.827	1.967	-	-
.03	1.881	2.042	2.069	1.985
.05	-	2.160	-	2.071
.1	2.130	-	-	-
.15	2.265	-	-	-

* Bottger, 1903

Data of Sirucek and Viktorin, 1939 (Con.)

Moles Salt per 1000 gms. of Water	$MgSO_4$	p-$ClC_6H_4SO_3Na$	$Al_2(SO_4)_3$	Na_2SO_4	Tl_2SO_4
0.001	-	-	-	-	0.961
.002	1.738	-	-	1.737	-
.0024	-	-	1.826	-	-
.003	-	-	-	-	0.484
.0042	-	-	1.887	-	-
.005	1.820	-	-	1.822	-
.0075	1.863	-	-	1.884	-
.008	-	-	1.736	-	0.232
.01	1.907	-	2.025	1.923	-
.02	2.027	-	-	2.065	-
.025	-	1.820	-	-	-
.04	2.180	-	-	-	-
.05	-	-	-	2.345	-
.053	-	1.905	-	-	-
.09	-	1.983	-	-	-
.1	-	2.019	-	-	-
.15	-	2.080	-	-	-

SOLUBILITY OF THALLOUS BROMIDE IN AQUEOUS SOLUTIONS AT 25°

(Keefer and Reiber, 1941a)

Results are expressed in Moles per 1000 gms. H_2O.

KNO_3	TlBr	Alanine	TlBr	Glycine	KNO_3	TlBr
0.0	2.013×10^{-3}	0.0249	2.033×10^{-3}	0.0249	-	2.032×10^{-3}
0.00502	2.100	.0498	2.052	.0499	-	2.059
.01003	2.163	.0749	2.070	.0500	0.05035	2.480
.01505	2.207	.1000	2.090	.0501	.1009	2.674
.02008	2.250			.0750	-	2.078
.02510	2.287			.1001	-	2.105
.05025	2.432			.1003	.0505	2.522
.07545	2.543			.1004	.1011	2.718
.1007	2.637			.1504	-	2.145
				.2010	-	2.193

Melting point data are given for:

TlBr - TlCl	Favorskii, 1940
TlBr - TlI	Tuttle and Egli, 1946

THALLIUM FORMATE $TlCO_2H$

CH

Freezing point data and the solubility of thallium formate in water up to 60° are reported by Taft and Horsley, 1942. The densities, conductivities, viscosities, and surface tensions of dilute solutions were also determined.

CH THALLIUM HYDROGEN TARTARATE $TlHC_4H_4O_6$

SOLUBILITY OF THALLOUS HYDROGEN TARTARATE IN AQUEOUS UREA AND DIOXANE SOLUTIONS

(Pedersen, 1941)

In Aqueous Dioxane at 18.00°		In Aqueous Urea at 17.85°	
Moles Dioxane per liter of Solvent	Moles $TlHC_4H_4O_6$ per liter Sat. Sol.	Moles Urea per liter of Solvent	Moles $TlHC_4H_4O_6$ per liter Sat. Sol.
0.000	0.02480	0.000	0.02471
.200	.02357	.250	.02580
.400	.02233	.500	.02693
.600	.02114	.750	.02809
.800	.02001	1.000	.02927

CH THALLIUM PICRATE $Tl[OC_6H_2(NO_2)_3]$

SOLUBILITY OF THALLIUM PICRATE IN AQUEOUS SALT SOLUTIONS AT 25°

(Otake, 1949)

Moles per liter

KNO_3	TlP	K_2SO_4	TlP	$K_2C_2O_4$	TlP	$Ba(NO_3)_2$	TlP
0.0	0.01112	0.00199	0.01160	0.00104	0.01131	0.00214	0.01159
.00106	.01123	.00527	.01214	.00516	.01220	.00524	.01210
.00499	.01158	.01257	.01328	.01103	.01325	.01176	.01342
.01000	.01202	.05076	.01528	.09463	.01592	.05269	.01576
.05000	.01335	.10017	.01775	.34357	.01988	.10012	.01790
.10028	.01443			1.01483	.02045	.37021	.02559
.50000	.01765						
.98507	.02105						

CNS THALLIUM THIOCYANATE TlCNS

SOLUBILITY OF THALLIUM THIOCYANATE IN GELATIN SOLUTIONS AT 40°

(Eversole and Thomas, 1943)

The addition of a gelatin was found to increase the water solubility of the salt and the effect is about the same whether isoelectric gelatin (pH ≃ 4.7) or cationic (HAc added until pH ≃ 3.6) or ionic (NaOH added pH ≃ 6) gelatin was used. Results are in grams per 1000 gms. of water.

pH ≃ 4.7		pH ≃ 3.6		pH ≃ 6	
Gelatin	TlCNS	Gelatin	TlCNS	Gelatin	TlCNS
0.0	7.39	23.17	8.14	23.01	7.93
22.30	7.82	44.03	8.58	43.25	8.39
45.20	8.35	63.03	9.17	64.12	8.77
66.58	8.58				

The solubility of thallous thiocyanate in solutions of egg albumin at 25° was determined by Eversole and Bjork, 1939.

Cl

THALLIUM CHLORIDE TlCl

SOLUBILITY OF THALLIUM CHLORIDE IN AQUEOUS SALT SOLUTIONS AT 20°

(Viktorin and Sirucek, 1939)

Concentrations are in moles per 1000 gms. H_2O

$NaSO_4$	TlCl	$NaNO_3$	TlCl	$MgSO_4$	TlCl
0.0	0.01376	0.005	0.01406	0.005	0.01466
.005	.01462	.01	.01428	.01	.01524
.01	.01523	.02	.01470	.02	.01610
.03	.01702	.05	.01567	.04	.01722
		.1	.01681		

SOLUBILITY OF THALLIUM CHLORIDE IN GLYCINE SOLUTIONS AT 25°

(Lee and Luh, 1948)

The data do not lie on a very smooth curve.

Moles Glycine per 1000 gms. H_2O	Moles TlCl per 1000 gms. Sat. Sol.	Moles Glycine per 1000 gms. H_2O	Moles TlCl per 1000 gms. Sat. Sol.
0.0	0.01594	0.6169	0.01820
.3619	.01798	.7978	.01913
.3849	.01777	.8008	.01953
.6060	.01788		

SOLUBILITY OF THALLIUM CHLORIDE IN GELATIN SOLUTIONS AT 40°

(Eversole and Thomas, 1943)

Addition of gelatin increases the aqueous solubility of the salt. Isoelectric (pH ≃ 4.7), positive (HAc added until pH ≃ 3.6) and negative (NaOH added until pH ≃ 6) gelatin all showed about the same effect.

Grams per 1000 gms. of Water

pH ≃ 4.7		pH ≃ 3.6		pH ≃ 6	
Gelatin	TlCl	Gelatin	TlCl	Gelatin	TlCl
0.0	6.12	19.70	6.35	20.33	6.41
25.13	6.31	41.65	6.57	43.30	6.80
44.89	6.34	65.40	6.60	64.42	6.97
70.74	6.74				

SOLUBILITY OF THALLOUS CHLORIDE IN PROTEIN SOLUTIONS

(Stone and Failey, 1938)

The results below are for solutions of isoelectric, electrolyte-free protein solutions. Additional determinations were made with these and other proteins in which the ionic strength of the solutions were varied.

Gms. Egg Albumin per 1000 gms. H_2O	Moles TlCl per 1000 gms. H_2O	Gms. Hemoglobin per 1000 gms. H_2O	Moles TlCl per 1000 gms. H_2O
5.61	0.01622	10.79	0.01620
11.13	.01624	15.16	.01631
19.31	.01640	22.77	.01638
29.63	.01646	26.85	.01648
39.14	.01647	31.03	.01657
47.49	.01667		

The solubility of thallous chloride in solutions of egg albumin at 25° was determined by Eversole and Bjork, 1939.

SOLUBILITY OF THALLIUM CHLORIDE IN MIXTURES OF ORGANIC SOLVENTS AND WATER AT 25°

(Black and Garrett, 1948)

	- % H_2O by Volume -					
	100	80	60	40	20	0
Ethylene Glycol + Water:						
Mole Fraction Glycol:	0.0	0.073	0.177	0.326	0.564	1.000
Density:	0.997	1.025	1.053	1.077	1.096	1.110
Moles TlCl per 1000 gms. Solvent:	0.01617	.01340	.01116	.00944	.00792	.00644
Dioxane + Water:						
Mole Fraction Dioxane:	0.0	0.052	0.121	0.257	0.474	1.000
Density:	0.997	1.015	1.028	1.035	1.035	1.027
Moles TlCl per 1000 gms. Solvent:	.01617	.00924	.00413	.00139	.00073	.00031
Morpholine + Water:						
Mole Fraction Morpholine:	0.0	0.050	0.121	0.240	0.457	1.000
Density:	0.997	1.011	1.027	1.034	1.030	0.996
Moles TlCl per 1000 gms. Solvent:	.01617	.01125	.00680	.00278	.00101	.00020

Cl

SOLUBILITY OF THALLIUM CHLORIDE IN ETHANOL - POTASSIUM CHLORIDE SOLUTIONS AT 25°

(Hogge and Garrett, 1941)

Moles per 1000 gms. Solvent		Density $d_4^{25°}$ (Sat. Sol.)	Moles per 1000 gms. Solvent		Density $d_4^{25°}$ (Sat. Sol.)
KCl	TlCl		KCl	TlCl	
Results in 10% Ethanol			**Results in 30% Ethanol**		
0.0	0.01166	0.9827	0.0	58.55×10^{-4}	0.9496
.02043	.05845	.9825	.01061	29.47	.9496
.05108	.003376	.9834	.02647	17.06	.9500
.1023	.002300	.9854	.05293	11.39	.9512
.2051	.001627	.9905	.1057	8.097	.9532
.3084	.001371	.9946	.1589	6.959	.9552
.5111	.001142	1.0158	.2658	6.009	.9591
1.0515	.001117	1.0259	.5361	5.49	.9694
2.195	.001416	1.0617	1.093	6.62	.9909
Results in 40% Ethanol					
0.0	40.58×10^{-4}	0.9337	.2157	4.238	.9423
.01071	16.62	.9342	.3246	4.006	.9467
.02145	10.01	.9342	.5440	4.18	.9558
.05369	6.653	.9351	1.108	5.20	.9774
.1075	5.064	.9377			

Data of Hogge and Garrett, 1941 (Con.)

Moles per 1000 gms. Solvent KCl	Moles per 1000 gms. Solvent TlCl	Density 25°_4 (Sat. Sol.)
Results in 51.25% Ethanol		
0.0	25.71×10^{-4}	0.9076
.01654	6.126	.9081
.03310	4.285	.9086
.08295	3.049	.9108
.1476	2.706	.9133
.1663	2.678	.9141
.1848	2.623	.9145
.3705	2.703	.9234
.7510	3.385	.9372
Results in 60% Ethanol		
0.0	17.93×10^{-4}	0.8882
.01409	3.612	.8886
.02819	2.636	.8889
.05637	2.078	.8903
.09318	1.875	.8921
.1414	1.789	.8934
.1698	1.826	.8961
.2839	1.867	.8992
.3760	1.991	.9028
.4715	2.141	.9065

Cl

SOLUBILITY OF THALLIUM CHLORIDE IN POTASSIUM CHLORIDE - ETHYLENE GLYCOL SOLUTIONS AT 25°

(Black and Garrett, 1943)

- Moles per 1000 grams of Solvent -

In 20 Wt. % Glycol KCl	In 20 Wt. % Glycol TlCl	In 40 Wt. % Glycol KCl	In 40 Wt. % Glycol TlCl	In 60 Wt. % Glycol KCl	In 60 Wt. % Glycol TlCl
0.0	0.01340	0.0	0.01116	0.0	0.00944
.0196	.00761	.0190	.00616	.0178	.00496
.0391	.00507	.0381	.00409	.0355	.00351
.0783	.00410	.0762	.00281	.0710	.00221
.0978	.00371	.0952	.00239	.0888	.00199
.5253	.00135	.1904	.00180	.1775	.00135
.7879	.00124	.4759	.00123	.4437	.00108
1.0501	.00110	.7615	.00054	.7099	.00065
		1.1423	.00051	1.0649	.00050

In 80 Wt. % Glycol KCl	In 80 Wt. % Glycol TlCl	In 100% Ethylene Glycol KCl	In 100% Ethylene Glycol TlCl
0.0	0.00792	0.0	0.00644
.0184	.00368	.0181	.00284
.0367	.00274	.0362	.00203
.0734	.00154	.0725	.00128
.0918	.00124	.0906	.00110
.1834	.00084	.1812	.00054
.4589	.00051	.4530	.00015
.7341	.00026		

ClO THALLIUM PERCHLORATE $TlClO_4$

SOLUBILITY OF THALLIUM PERCHLORATE IN WATER AND DEUTERIUM OXIDE
(Noonan, 1948)

Solvent	Moles $TlClO_4$ per 100 moles of Solvent			
	5°	15°	25°	35°
H_2O	0.3978	0.615	0.921	1.337
91.6% D_2O	-	-	0.763	1.129
99.7% D_2O	0.304	0.488	-	-
100% D_2O	0.304	0.488	0.748	1.110

CrO THALLIUM CHROMATE Tl_2CrO_4

Reaction in the system Tl_2CrO_4 + MgO at 300° was studied by Montignie, 1941a.

I THALLIUM IODIDE TlI

SOLUBILITY OF THALLIUM IODIDE IN AQUEOUS SALT SOLUTIONS AT 20°
(Viktorin and Sirucek, 1939)

Moles Salt per 1000 gms. of Water	Moles TlI per 1000 gms. of Water x 10^4					
	$NaNO_3$	$MgSO_4$	$Ba(NO_3)_2$	$p\cdot ClC_6H_4SO_3Na$	$(NH_4)_2SO_4$	Na_2SO_4
0.0	1.901	-	-	-	-	-
.001	-	1.988	-	-	2.064	-
.005	1.999	-	2.103	-	2.225	2.130
.0075	-	2.191	-	-	-	-
.01	-	-	-	2.040	-	2.268
.011	-	-	-	-	2.390	-
.02	-	2.375	2.312	-	-	-
.025	-	-	-	-	-	2.512
.04	2.254	2.553	-	-	-	-
.05	-	-	2.502	-	-	-
.06	-	-	-	-	-	2.819
.075	-	-	-	2.317	-	-
.10	2.508	-	-	-	-	-
.15	-	-	-	2.458	-	-
.16	2.684	-	-	-	-	-

EQUILIBRIUM IN THE SYSTEMS THALLOUS IODIDE - IODINE - BENZENE AND THALLOUS IODIDE - IODINE - TOLUENE AT 6°
(Foote and Fleischer, 1940)

With Toluene		With Benzene	
Wt. % I_2 in Solution	Solid Phase	Wt. % I_2 in Solution	Solid Phase
0.044	$TlI + Tl_6I_8$	0.038	$TlI + Tl_6I_8$
.17	Tl_6I_8	.18	Tl_6I_8
.74	"	.36	"
1.51	"	.75	"
1.75	"	1.40	"
1.81	"	1.43	"
2.28	$Tl_6I_8 + TlI_3$	1.57	"
2.97	TlI_3	1.98	$Tl_6I_8 + TlI_3$
9.40	"	3.07	TlI_3
10.12	$TlI_3 + I_2$	8.27	"
		8.63	$TlI_3 + I_2$

Reaction in the system TlI + MgO at 300° was studied by Montignie, 1941a.

THALLIUM IODATE $TlIO_3$ IO

SOLUBILITY OF THALLIUM IODATE IN AQUEOUS ALKANE DISULFONATE SOLUTIONS AT 25°

(Stone, 1940)

The solvent salts had the general formula $NaO_3S(CH_2)_xSO_3Na$. Results are in moles $TlIO_3$ per liter x 10^{-6}. The solubility of $TlIO_3$ in water was 1833×10^{-6} moles per liter.

	Molarity of Solvent Salt Solution					
x	0.0200	0.0100	0.0050	0.0020	0.0010	0.0005
1	2300	2138	2036	1937	1897	1867
2	2220	2094	2009	1927	1887	1868
3	2216	2094	2007	1924	1890	1868
4	2207	2093	2003	1921	1891	1860
5	2198	2079	1997	1915	1884	1860
6	2196	2084	1995	1920	1890	1860
10	2176	2071	1994	1924	1885	1861
14	2135	2054	1977	-	1873	1856

SOLUBILITY OF THALLOUS IODATE IN AQUEOUS UREA AND DIOXANE SOLUTIONS

(Pederson, 1941)

17.85°		18.00°	
Moles Urea per 1000 ml. Solvent	Moles $TlIO_3$ per 1000 ml. Sat. Sol.	Moles Dioxane per 1000 ml. Solvent	Moles $TlIO_3$ per 1000 ml. Sat. Sol.
0.000	1.410×10^{-3}	0.000	1.417×10^{-3}
.250	1.467	.250	1.315
.500	1.526	.500	1.213
.750	1.586	.750	1.117
1.000	1.644		

SOLUBILITY OF THALLOUS IODATE IN AQUEOUS GLYCINE AND ALANINE SOLUTIONS AT 25°

(Keefer and Rieber, 1941a)

	Moles Glycine or Alanine per 1000 gms. H_2O				
Moles $TlIO_3$ per 1000 gms. H_2O with:	0.0	0.0498	0.1000	0.1503	0.2010
Glycine	.001850	.001909	.001976	.002037	.002103
Alanine	.001850	.001896	.001947	.001999	.002043

SOLUBILITY OF THALLIUM IODATE IN AQUEOUS SOLUTIONS OF SODIUM SALTS OF BENZENE CARBOXYLLIC ACIDS AT 25°

(Failey, 1946)

S = Solubility of $TlIO_3 \times 10^6$ in moles per liter. Concentrations of the solvent salts are in moles per liter.

IO

Sodium Benzoate:	0.0	0.02	0.05	0.10	0.20	
S :	1834	2057	2228	2429	2723	
" o-Phthalate:	.001333	.002667	.00667	.01333	.03333	0.667
S :	1930	2005	2172	2377	2798	3287
" m-Phthalate :	.00667	.01333	.03333	.0667		
S :	2053	2171	2401	2655		
" p-Phthalate :	.00667	.01333	.03333	.0667		
S :	2046	2156	2373	2613		
" Trimesate:	.003333	.00667	.01667	.03333		
S :	2069	2189	2416	2661		
Sodium Benzene penta- Carboxylate :	.0001067	.0002666	.000533	.001334	.002666	
S :	1908	2029	2212	2636	3123	
Sodium Pyromellitate:	.0004	.0008	.002	.004	.010	.0120
S :	1944	2029	2214	2458	2818	3224

Data are also given for the solubility of thallium iodate in solutions containing a fixed concentration of one of the above salts with varying amounts of NaCl, $MgCl_2$, or $NaNO_3$ in addition.

NO THALLIUM NITRATE $TlNO_3$

SOLUBILITY OF THALLIUM NITRATE IN WATER AND DEUTERIUM OXIDE

(Noonan, 1948)

t°	Moles $TlNO_3$ per 100 moles of Solvent			
	90.86% D_2O	91.59% D_2O	92.36% D_2O	100% D_2O
5	-	-	0.263	0.258
15	-	-	.415	.407
25	-	-	.638	.622
28.37	0.739	-	-	.722
30.11	.793	-	-	.775
35.0	-	0.961	-	.941

OH THALLIUM HYDROXIDE (ic) $Tl(OH)_3$

Oka, 1940 found the solubility in water to be 1.3×10^{-9} moles per liter by potentiometric titration.

THALLIUM SULFATE Tl_2SO_4 SO

Correction to Volume I: p. 1558 "Thallium Double Sulfates"

The reference should be "Locke, 1902"

SOLUBILITY OF THALLIUM SULFATE IN GELATIN SOLUTIONS AT 40°
(Eversole and Thomas, 1948)

Addition of gelatin usually increases the aqueous solubility of the salt. Isoelectric (pH $\simeq$ 4.7), positive (HAc added until pH $\simeq$ 3.6), and negative (NaOH added until pH $\simeq$ 6) gelatin all showed about the same effect.

Grams per 1000 gms. of Water

pH $\simeq$ 4.7		pH $\simeq$ 3.6		pH $\simeq$ 6	
Gelatin	Tl_2SO_4	Gelatin	Tl_2SO_4	Gelatin	Tl_2SO_4
0.0	76.0	22.49	75.6	21.71	76.3
20.78	76.1	48.23	74.9	45.88	77.0
46.52	77.5	67.20	74.5	65.16	77.9
63.80	78.9				

The solubility of thallous sulfate in solutions of egg albumin at 25° was determined by Eversole and Bjork, 1939.

URANYL CHLORIDE UO_2Cl_2 Cl

The densities and molar volumes of dilute uranyl chloride solutions at 25° were determined by Karistinski and Lipilina, 1948.

URANYL NITRATE $UO_2(NO_3)_2$ NO

SOLUBILITY OF URANYL NITRATE IN WATER ABOVE 100°
(Benrath, 1942)

t°	Wt. % $UO_2(NO_3)_2$	t°	Wt. % $UO_2(NO_3)_2$	t°	Wt. % $UO_2(NO_3)_2$
80	79	115	84.6	156	87.9
94	80.6	116	85.8	175	90.5
108	82.9	138	86.7	187	91.6

The densities and molar volumes of dilute uranyl nitrate solutions at 25° were determined by Karistinski and Lipilina, 1948.

DISTRIBUTION OF URANYL NITRATE ETHER AND NITRIC ACID SOLUTIONS AT 20°
(Norstrom and Sillen, 1948)

At least two determinations of the concentrations of uranium were made at each acid strength. Only one of these is listed below, and the values for "Q", the ratio of the amounts of U_3O_8 in equal volumes of each phase, indicate the variations found at each concentration.

Data of Norstrom and Sillen, 1948

- Results in Nitric Acid Solutions -

Moles H^+ per liter		$\underline{Q}$ H	Mg. U_3O_8 per 10 ml.		$\underline{Q}$ U_3O_8
Aqueous Phase	Ether Phase		Aqueous Phase	Ether Phase	
5.57	3.94	0.71	14.8	32.5	2.03 - 2.20
4.72	3.31	.70	14.2	33.0	2.33 - 2.37
4.4	3.0	.68	17.5	36.8	2.02 - 2.13
4.32	2.99	.69	14.7	34.0	2.00 - 2.42
3.94	2.65	.67	17.2	34.9	2.02 - 2.04
3.74	2.44	.65	16.7	37.1	2.15 - 2.22
3.35	1.99	.59	15.8	33.7	2.13 - 2.54
2.74	1.25	.46	26.2	26.5	0.97 - 1.02
2.60	1.09	.42	30.6	22.9	0.75 - 0.79
2.52	0.97	.39	34.7	16.5	0.48 - 0.64
2.5	.96	.38	35.7	17.3	0.47 - 0.56
2.00	.53	.26	41.6	8.6	0.201 - 0.206
1.60	.29	.18	46.0	3.9	0.080 - 0.086
1.5	.26	.17	46.0	3.6	0.063 - 0.078
0.75	.06	.08	48.7	0.5	0.010 - 0.013

- Results in Nitric Acid Solutions Saturated with Ammonium Nitrate -

3.42	3.64	1.06	11.2	25.8	2.30 - 2.60
2.73	3.07	1.12	11.6	30.7	2.65 - 2.73
2.43	2.87	1.18	12.6	30.5	2.39 - 2.52
2.31	2.67	1.15	10.2	32.1	2.87 - 3.22
1.72	2.19	1.27	10.7	33.7	3.13 - 3.27
1.13	1.45	1.29	9.1	33.7	3.70
1.12	1.46	1.30	9.5	34.3	3.44 - 3.61
1.08	1.25	1.15	11.6	33.9	2.92 - 2.95
0.98	1.20	1.23	12.0	35.3	2.94 - 3.08
.96	1.18	1.23	10.8	32.2	2.85 - 3.09
.61	0.77	1.26	11.8	31.3	2.55 - 2.65
.60	.74	1.24	11.5	29.9	2.60 - 2.63
.27	.33	1.23	12.6	28.2	2.17 - 2.24
.26	.31	1.20	12.3	27.0	2.00 - 2.20
.11	.13	1.18	12.8	26.4	2.06 - 2.19
.10	.12	1.16	12.7	24.7	1.88 - 2.02

Additional data which are in good agreement with those of Norstrom and Sillen are given by Juttner, 1901; Bogden, 1905, 1906; Pavlov, 1924; and Archibald, 1932.

SOLUBILITY OF URANYL NITRATE IN ORGANIC SOLVENTS AT 20°

(Yaffe, 1949)

Each solvent was shaken with $UO_2(NO_3)_2 \cdot 6H_2O$ from one to four days. The salt was then extracted from the solution with water and determined colorimetrically. A large number of other solvents were used in which the solubility was "less than 0.1 gms. per 100 ml."

Solvent	Gms. $UO_2(NO_3)_2 \cdot 6H_2O$ per 100 ml. Solvent	Solvent	Gms. $UO_2(NO_3)_2 \cdot 6H_2O$ per 100 ml. Solvent
Diethyl Cellosolve	102	Dibutoxytetraethylene Glycol	90
Dimethyl Cellosolve	92	Isobutylcarbinol	57
Diethyl Ether	74	Diethylcarbinol	57
Ethylhexyl Cellosolve	68	n-Amyl Alcohol	55
Dibutyl Cellosolve	49	2-Ethyl Butyl Alcohol	49
Dibutyl Carbitol	44	Methyl Amyl Alcohol	43
Pelargonic Ether	17	n-Heptyl Alcohol	43
n-Butyl Ether	16	Capryl Alcohol	37
Xanthyl Ether	14	Geraniol	36
Amyl Ether	11	β, γ-Dibromopropanol	32
Hexyl Ether	9	Undecanol	27
Isopropyl Ether	9	Tetradecanol	13
Dichloroisopropyl Ether	5	Cyclohexanone	105
β-Ethoxyl Ethyl Acetate	125	Methyl Ethyl Ketone*	100
Ethyl Acetylglycollate	110	Diethyl Ketone	76
Ethyl Acetate	82	Methyl Isobutyl Ketone	75
Butyl Cellosolve Acetate	77	Methyl n-Amyl Ketone	68
Butyl Acetate	68	Diisopropyl Ketone	41
Isopropyl Acetate	64	Acetaldehyde	42
sec-Butyl Acetate	61	Citronellal	34
Amyl Formate	56	Anisaldehyde	27
n-Butyl Propionate	55	n-Butyraldehyde	22
Isoamyl Acetate	55	Nitromethane	64
Isobutyl Acetate	50	Triglycol Dichloride	57
Ethyl Sebacate	48	1-Nitropropane	8
Amyl Acetate	46	2-Nitropropane	4
Butyl Adipate	40	Nitrobenzene	1.5
n-Butyl Sebacate	37	Tetrabutyl Urea	6.0
n-Amyl Propionate	37	Amyl Succinate	25
β-Phenyl Ethyl Acetate	35	Amyl Butyrate	25
Methyl Phenyl Acetate	33	Isoamyl Formate	24
Isobutyl Propionate	31	Amyl Valerionate	21
Vinyl Acetate	31	Geraniol Acetate	16
Isoamyl Propionate	27	n-Butyl Oxalate	9
		Isoamyl n-Caproate	7

* plus 15% Xylene

NO

SOLUBILITY OF URANYL NITRATE IN ETHER

(Bachelet and Cheylan, 1947)

Although the solubility curve drawn by them shows no breaks, the authors report the formation of two etherates upon evaporation: $UO_2(NO_3)_2 \cdot 2H_2O \cdot 2(C_2H_5)_2O$, M.P. 45° and $UO_2(NO_3)_2 \cdot 2H_2O \cdot 4(C_2H_5)_2O$, M.P. 2.2°. The following data were read from the authors' rather rough curve.

Temperature°:	-80	-40	-20	0	20	40
Gms. $UO_2(NO_3)_2 \cdot 2H_2O$ per 100 gms. Ether:	10	22	50	88	127	175

SO **URANYL SULFATE UO_2SO_4**

SOLUBILITY OF URANYL SULFATE IN WATER

(Secoy, 1948)

t°	Moles UO_2SO_4 per 1000 gms. H_2O	Solid Phase
-0.0705	0.03[d]	Ice
- .1100	.05[d]	"
- .200	.10[d]	"
- .516	.30[d]	"
- .948	.60[d]	"
-17.7	2.87	"
-22.9	3.33	"
-38.5	3.82	Ice + $UO_2SO_4 \cdot 3H_2O$
-27.0	3.84	$UO_2SO_4 \cdot 3H_2O$
30.0	4.135	"
35.0	4.171	"
40.0	4.225	"
46.8	4.31	"
57.3	4.50	"
71.7	4.73	"
80.8	4.70	"
90.1	5.02	"
93.5	5.06	"
106.2	5.26	$UO_2SO_4 \cdot 3H_2O$
116.8	5.59	"
118.4	5.73	"
119.9	5.66	"
125.2	5.90	"
134.9	6.25	"
139.0	6.51	"
140.7	6.55	"
145.1	6.72	"
149.6	6.89	"
153.6	7.14	"
168.6	7.75	"
181	8.66	$UO_2SO_4 \cdot 3H_2O$ + $UO_2SO_4 \cdot H_2O$
152	8.97	$UO_2SO_4 \cdot H_2O$
287	7.75	"
49.2[m]	4.70	$UO_2SO_4 \cdot 2H_2O$
53.2[m]	4.73	"
75.5[m]	5.06	"

[d] = Dittrick, 1899

[m] = Metastable

VANADIUM DIOXIDE VO_2

EQUILIBRIUM IN THE SYSTEM VANADIUM DIOXIDE - SULFUR TRIOXIDE - WATER AT 30°

(Rohrer, Lanford, and Kiehl, 1942)

Gms. per 100 gms. Sat. Sol.		Density	Solid Phase	Gms. per 100 gms. Sat. Sol.		Density	Solid Phase
VO_2	SO_3			VO_2	SO_3		
0.0068	0.0	0.996	a	6.04	37.50	1.448	c
3.45	3.33	1.048	a	2.27	46.96	1.506	c
7.21	6.83	1.096	a	2.11	48.17	1.517	c
11.51	10.93	1.231	a	2.05	50.96	1.662	c
13.41	12.78	1.278	a	2.19	52.45	1.578	c
16.19	15.40	1.361	a	2.80	51.91	1.583	d*
20.21	19.02	1.468	a	2.51	52.27	1.589	d*
24.10	22.22	1.595	a*	0.96	55.24	1.593	d*
25.41	23.38	1.639	a*	.37	58.06	1.622	d
25.90	23.83	1.663	a*	.275	58.89	1.582	d
21.14	20.09	1.508	b	.245	59.58	1.717	d
17.24	22.35	1.473	b	.072	65.52	1.754	d
17.28	22.50	1.461	b	.080	69.09	1.783	d
12.40	26.77	1.427	b	.080	71.16	1.787	d
11.24	27.40	1.422	b	.088	72.97	1.795	d
8.11	32.35	1.416	b	.097	73.67	1.801	e
6.70	35.44	1.436	b	.086	74.46	1.844	e
6.52	36.11	1.441	b	.081	74.56	1.811	e
17.35	28.09	1.535	c*	.062	79.17	1.827	e
17.36	28.09	-	c*	.041	80.18	1.827	e
14.77	29.71	1.506	c*	.035	80.58	1.835	e
13.52	30.72	1.496	c*	.036	81.02	1.825	e
11.73	31.64	-	c*				

* = Metastable a = $VO_2 \cdot H_2O$ b = $VO_2 \cdot SO_3 \cdot 5H_2O$

c = $VO_2 \cdot SO_3 \cdot 3H_2O$ d = $2VO_2 \cdot 3SO_3 \cdot 4H_2O$ e = $VO_2 \cdot SO_3$

Melting points in the systems VO_2 - CaO and VO_2 - SiO_2 were determined by Morozov, 1939.

VANADIUM TRIOXIDE V_2O_3

Melting points in the systems V_2O_3 - CaO and V_2O_3 - SiO_2 were determined by Morozov, 1939.

VANADIUM PENTOXIDE V_2O_5

EQUILIBRIUM IN THE SYSTEM V_2O_5 - SO_3 - H_2O

(Marakov and Repa, 1938; Lanford and Kiehl, 1940)

At 25° and 75°, Marakov and Repa found four stable solid phases, none of which contained SO_3. At 30° however, Lanford and Kiehl found that three of the solids were hydrated compounds of SO_3 + V_2O_5. The later authors do not mention the data of Marakov and Repa, although the general shape of the solubility curves are the same in each case, it is hard to tell which data and solid phases represent the true equilibrium. Marakov's data may also be found in the article by Marakov and Repa(1940) on the system Na_2O - SO_3 - V_2O_5 - H_2O.

Gms. per 100 gms. Saturated Solution		Gms. per 100 gms. Solid Phase		Solid Phase
V_2O_5	H_2SO_4	V_2O_5	H_2SO_4	
Results at 25° (Marakov and Repa)				
0.04	0.0	-	-	$V_2O_5 \cdot 3H_2O$
0.79	2.61	24.95	2.00	"
2.02	17.98	18.06	14.10	"
4.26	26.34	20.62	20.25	"
4.53	26.96	33.44	16.51	"
5.10	27.94	19.39	22.00	"
5.90	28.15	14.09	25.80	$V_2O_5 \cdot 3H_2O + V_2O_5 \cdot 2H_2O$
5.64	31.28	26.12	23.10	$V_2O_5 \cdot 2H_2O$
3.82	37.98	28.23	26.35	"
3.40	39.50	12.04	35.30	"
4.73	41.52	16.45	35.15	$V_2O_5 \cdot 2H_2O + V_2O_5 \cdot H_2O$
1.85	47.81	19.30	38.60	$V_2O_5 \cdot H_2O$
6.90	52.50	11.90	49.68	"
6.83	52.40	18.81	45.53	"
10.37	52.93	24.05	43.90	"
12.48	53.17	21.30	47.82	$V_2O_5 \cdot H_2O + V_2O_5$
10.79	59.09	18.57	51.90	V_2O_5
10.24	58.70	15.24	54.13	"
1.01	90.60	13.33	78.93	"
Results at 75° (Marakov and Repa)				
0.95	0.0	-	-	$V_2O_5 \cdot 3H_2O$
1.48	17.43	16.33	14.18	"
2.00	24.18	25.10	17.00	"
2.01	24.43	27.24	16.50	"
5.06	33.00	26.20	23.01	"
6.10	34.30	25.80	25.50	$V_2O_5 \cdot 3H_2O + V_2O_5 \cdot 2H_2O$
5.48	38.02	23.24	29.17	$V_2O_5 \cdot 2H_2O$
5.27	41.01	26.29	30.01	"
5.13	46.50	15.40	41.50	"
8.29	49.53	24.06	39.48	$V_2O_5 \cdot 2H_2O + V_2O_5 \cdot H_2O$
8.09	52.31	20.79	44.52	$V_2O_5 \cdot H_2O$
9.08	57.33	15.32	52.78	"
11.96	57.56	20.86	51.41	$V_2O_5 \cdot H_2O + V_2O_5$
10.80	60.20	21.25	53.00	V_2O_5
7.51	64.98	21.20	55.10	"
7.52	70.50	22.20	59.30	"
0.13	93.44	6.27	87.89	"

Results at 30° (Lanford and Kiehl)

Saturated Solution Mole %		Density	Moist Solid Phase Mole %		Solid Phase
V_2O_5	SO_3		V_2O_5	SO_3	
0.011	0.000	0.996	2.42	0.00	–
.094	.684	1.030	1.34	.73*	–
.172	1.428	1.066	2.63	1.28*	V_2O_5
.212	1.742	1.070	1.82	1.71*	"
.270	2.150	1.091	–	–	"
.459	4.232	1.178	1.96	4.02*	"
.587	5.341	1.219	2.03	5.33*	"
.850	8.04	1.319	–	–	"
1.051	9.81	1.370	2.88	9.52	"
1.388	11.26	1.440	2.95	12.21	$V_2O_5 + V_2O_5 \cdot 2SO_3 \cdot 8H_2O$
1.060	11.11	1.418	2.68	12.55	$V_2O_5 \cdot 2SO_3 \cdot 8H_2O$
0.870	11.32	–	1.75	12.07	"
.646	12.24	–	1.88	13.07	"
.600	13.53	–	1.36	13.96	"
.578	13.75	1.443	2.01	14.63	"
.620	14.58	1.466	1.74	15.01	"
.898	16.46	1.519	2.40	16.72	"
1.690	20.73	1.661	3.49	20.08	"
2.030	22.33	1.734	3.42	22.72	$V_2O_5 \cdot 2SO_3 \cdot 8H_2O + V_2O_5 \cdot 2SO_3 \cdot 3H_2O$
1.920	22.26	1.717	3.52	23.62	$V_2O_5 \cdot 2SO_3 \cdot 3H_2O$
1.690	22.34	1.694	2.69	23.23	"
1.580	22.47	1.695	2.89	23.57	"
1.020	23.20	–	3.06	24.71	"
0.710	24.34	–	2.29	25.36	"
.306	26.72	–	3.48	28.12	"
.311	28.15	–	3.57	29.15	"
1.280	28.00	–	2.54	30.16m	$V_2O_5 \cdot 4SO_3 \cdot 4H_2O$
0.601	28.23	1.739	3.79	33.48m	"
.560	28.28	1.731	3.41	33.12m	"
.360	28.61	1.708	2.74	32.36m	"
.056	30.22	1.727	2.16	32.97	"
.019	32.78	1.745	2.20	35.17	"
.018	36.91	1.790	2.63	38.11	"
.015	39.43	1.799	2.26	40.48	"
.014	48.93	1.817	2.59	47.75	"
.300	28.68	1.714	2.37	26.67	$V_2O_5 \cdot 4SO_3 \cdot 4H_2O + V_2O_5 \cdot 2SO_3 \cdot 3H_2O$

m = Metastable * = Original Complex

SOLUBILITY OF VANADIUM PENTOXIDE IN SULFURIC ACID SOLUTIONS

(Meyer and Aulich, 1930)

Solvent ($H_2SO_4 + H_2O$)		Gms. V_2O_5 per 100 gms. Sat. Sol.	
Density	Wt. % H_2SO_4	25°	100°
1.000	0.0	0.07	0.07
1.055	8.07	1.87	1.69
1.106	15.2	2.62	2.02
1.233	31.5	2.00	2.55
1.378	47.8	2.04	1.87
1.549	64.2	2.62	3.69
1.651	73.0	3.99	6.68
1.776	84.1	10.81	4.27
1.810	88.04	15.03	2.71
1.828	91.7	2.73	1.32
1.840	98.5	1.49	0.7

SOLUBILITY OF VANADIUM PENTOXIDE IN ACID SOLUTIONS

(Britton and Welford, 1940)

O	Normality of Solvent		18°		100°	
			Gms. V_2O_5 per liter	Moles V_2O_5 per liter	Gms. V_2O_5 per liter	Moles V_2O_5 per liter
	HCl	2.00N	36.40	0.200	32.60	0.179
		0.500	12.05	.0662	10.65	.0585
		0.200	5.40	.0297	4.30	.0237
	HNO_3	0.900N	22.80	0.125	14.95	0.0822
		0.400	11.60	.0638	7.05	.0387
		0.100	2.85	.0157	1.90	.0104
	$HClO_4$	0.375N	10.10	0.0555	-	-
		0.094	2.85	.0157	-	-
	H_2SO_4	1.800N	32.55	0.179	20.60	0.113
		0.750	12.25	.0838	8.70	.0479
		0.180	4.15	.0228	2.10	.115
	$NaHSO_4$	0.450N	8.15	0.0448	2.30	0.0127
		0.225	4.30	.0237	1.15	.0063
		0.090	1.95	.0107	0.55	.0030
	CCl_3COOH	0.888N	12.50	0.0687	-	-
		0.222	5.80	.0318	-	-
		0.089	2.60	.0143	-	-
	CH_3COOH	2.000N	0.40	0.0022	-	-
		.500	0.55	.0030	-	-
		.200	0.80	.044	-	-

Melting points in the systems V_2O_5 + CaO and V_2O_5 + SiO_2 were determined by Morozov, 1939.

Xe XENON

SOLUBILITY OF XENON IN WATER

Lawrence, et al, 1946 plotted the results of Von Antropoff 1910, 1919, and Valentiner, 1927, 1930 and drew a smooth curve through the data. Those of Von Antropoff from 1910 are distinctly lower than the rest, which are in excellent agreement from 0° to 70°. The values below were read from Lawrence's curve: [β = The Bunsen adsorption coefficient = ml. Xe (measured at 0°, 760 mm.) dissolved in 1 ml. of water at the temperature of the experiment].

	0°	10°	20°	30°	40°	50°	60°	70°
β =	0.245	0.175	0.130	0.097	0.080	0.069	0.062	0.057

SOLUBILITY OF XENON IN OLIVE OIL

(Loomis, 1946)

Temperature	22°	37°
β =	1.9	1.7

Cl

YTTRIUM CHLORIDE YCl_3

100 cc. of water, saturated with HCl at 0° (1 atm.) contain 0.024 gms. Y_2O_3.

100 cc. of a mixture of equal volumes of ether and water, saturated with HCl at 0° (1 atm) contain 0.0015 gms. Y_2O_3.

Fischer, W., and Z.-Pf., 1949

NO

YTTRIUM NITRATE $Y(NO_3)_3$

The solubility of a mixture of rare earth nitrates containing 23% $Y(NO_3)_3$ was found to be 12.0 gms. of anhydrous nitrates per 100 gms. of saturated solution in isoamyl alcohol, and 3.22 gms. per 100 gms. saturated solution in methyl n-hexyl ketone at room temperature.

When a mixture of rare earth nitrates containing 10% $Y(NO_3)_3$ is shaken with n-hexyl ketone and water at room temperature the distribution ratio was found to be less than 0.0012, with 33.0% of the anhydrous nitrates in the aqueous phase.

(Rothschild, Templeton, and Hall, 1948)

10 ml. of a saturated solution of yttrium nitrate in ether at 20° contain 80.3 mg. Y_2O_3 (Wells, 1930).

OH

YTTRIUM HYDROXIDE $Y(OH)_3$

Oka, 1940 found the solubility to be 1.8×10^{-6} moles per liter by potentiometric titration.

BO

ZINC BORATES $xZnO \cdot yB_2O_3$

Melting point diagrams for the systems $ZnO + B_2O_3$ and $ZnO + B_2O_3 + SiO_2$ are given by Ingerson, Morey, and Tuttle, 1948.

Br

ZINC BROMIDE $ZnBr_2$

SOLUBILITY OF ZINC BROMIDE IN DIETHYL ETHER

(Rowley and Anderson, 1941)

t°	Gms. $ZnBr_2$ per 100 gms. Ether	Solid Phase	t°	Gms. $ZnBr_2$ per 100 gms. Ether	Solid Phase
-20	47.7	$ZnBr_2 \cdot 2(C_2H_5)_2O$	5	178.3	$ZnBr_2 \cdot (C_2H_5)_2O$
-15.8	67.2	"	10	195.7	"
-10	92.3	"	15	222.6	"
- 5	107.7	"	20	231.8	$ZnBr_2$
0	133.3	"	25	236.0	"
			35	243.5	"

CCl

ZINC TETRACHLOROPHTHALATE $Zn[C_6Cl_4(COO)_2]$

100 gms. of a saturated solution in water at 25° contain 3.0 gms. of the Salt.
" " " " " " " " 75° " 2.0 " " " "

(Lawlor, 1947)

CH ZINC ACETATE $Zn(CH_3COO)_2$

SOLUBILITY OF ZINC ACETATE IN LITHIUM NITRATE SOLUTIONS IN ACETIC ACID

(Griswald, Ash, and McReynolds, 1945)

R = Mole % $LiNO_3$ in Solvent S = Mole % $Zn(CH_3COO)_2$ in Sat. Sol.

The solid phase was unsolvated zinc acetate throughout.

S	t°	S	t°	R	S
R = 1.450		R = 9.60		Temperature = 30°	
0.1020	37.7	0.786	35.6	0.000	0.056
.1295	48.2	1.005	46.0	0.663	.055
.1799	56.9	1.063	49.8	1.021	.073
.2352	66.0	1.262	58.1	1.353	.092
.3102	77.5	1.462	67.8	1.694	.129
.3651	83.0	2.067	80.3	2.49	.159
				3.02	.204
R = 3.90		R = 11.90		3.69	.251
				4.38	.309
.317	41.1	1.210	39.9	5.40	.356
.352	47.7	1.386	47.1	6.40	.433
.448	57.5	1.631	57.7	7.42	.525
.539	65.1	1.937	69.0	8.46	.574
.650	73.8	2.230	74.6	9.48	.612
.741	79.1	2.941	86.0	10.51	.660
R = 8.00					
.799	47.7	1.150	65.0		
.902	53.5	1.339	71.5		
.981	57.6	1.559	77.8		

SOLUBILITY OF ZINC ACETATE IN LITHIUM ACETATE SOLUTIONS IN ACETIC ACID

(Griswold and Van Horne, 1945)

R = Mole % $Li(CH_3COO)$ in Solvent R = Mole % $Zn(CH_3COO)_2$ in Sat. Sol.

S	t°	S	t°	S	t°
R = 2.50 Solid Phase $Zn(Ac)_2$		R = 7.97 Solid Phase 1:2:4		R = 10.00 Solid Phase 1:2:4	
0.705	35.0	1.44	14.0	1.43	16.5
0.800	47.0	1.82	18.3	2.03	22.0
1.106	75.3	2.09	20.9	2.16	22.6
1.170	79.5	2.25	21.2	2.33	23.8
		2.35	22.9	2.50	25.3
R = 5.00 Solid Phase $Zn(Ac)_2$		R = 10.00 Solid Phase $Zn(Ac)_2$		2.78	26.8
1.565	37.9	2.70	41.8	R = 12.50 Solid Phase $Zn(Ac)_2$	
1.572	38.0	2.99	52.6	3.45	51.5
1.604	42.0	3.07	56.7	3.96	67.0
1.887	59.5	3.27	61.8	4.28	74.6
1.897	63.5	3.53	69.2	4.61	82.9
2.416	83.8	3.55	69.6	4.77	86.6
2.445	84.7	3.81	77.3	5.08	93.0
		3.99	81.5		

Data of Griswold and Van Horne, 1945 (Con.)

S	t°	S	t°
R = 7.97 Solid Phase $Zn(Ac)_2$		R = 12.50 Solid Phase 1:2:4	
2.04	36.7	2.53	28.4
2.13	39.7	2.86	30.5
2.35	47.6	3.69	35.1
3.07	66.6	3.96	36.9
3.31	72.6	4.03	36.7
3.45	75.8	4.28	37.4
4.14	90.1		

1:2:4 = $Zn(CH_3COO)_2 \cdot 2Li(CH_3COO) \cdot 4CH_3COOH$

Isothermal curves (50°, 70°) are also presented which show the solubility of zinc acetate in acetic acid with added lithium acetate.

ZINC ANTHRACENE SULFONATES $Zn(C_{14}H_9SO_3)_2$ $ZnC_{14}H_9S_2O_6$ CH

SOLUBILITY IN WATER
(Federov and Lodygin, 1942)

Salt	Gms. Salt per 100 gms. Sat. Sol. 20°	100°
α-$Zn(C_{14}H_9SO_3)_2 \cdot 6H_2O$	0.048	0.443
β-$Zn(C_{14}H_9SO_3)_2 \cdot 6H_2O$	.0074*	.131
1,8-$ZnC_{14}H_8S_2O_6 \cdot 4H_2O$	.155	.708
1,5-$ZnC_{14}H_8S_2O_6 \cdot 3H_2O$	2.389	5.819
2,6-$ZnC_{14}H_8S_2O_6 \cdot 6H_2O$	0.054	0.275
2,7-$ZnC_{14}H_8S_2O_6 \cdot 4H_2O$	.573	1.806

* Ephriam and Pfister, See Vol. I, p. 1579

ZINC OXALATE ZnC_2O_4 CO

SOLUBILITY OF ZINC OXALATE IN ZINC SULFATE SOLUTIONS AT 25°
(Vosburgh and Beckman, 1940)

Moles x 10^3 per liter of Saturated Solution

$ZnSO_4$	-	0.0	5	10	20	40
ZnC_2O_4	-	0.168	0.167	0.202	0.269	0.386

Cl ZINC CHLORIDE $ZnCl_2$

SOLUBILITY OF ZINC CHLORIDE IN HYDROCHLORIC ACID SOLUTIONS AT 25°
(Kuznetsov and Kozhukovskii, 1936)

Gms. per 1000 gms. H_2O		Solid Phase	Gms. per 1000 gms. H_2O		Solid Phase
$ZnCl_2$	HCl		$ZnCl_2$	HCl	
4291	0.0	$ZnCl_2$	3758	356.5	$2ZnCl_2 \cdot HCl \cdot 2H_2O$
4063	104.3	"	3285	428.9	"
4153	156.7	"	2593	578.2	"
4214	217.3	"	2488	647.8	"
3891	300.0	$2ZnCl_2 \cdot HCl \cdot 2H_2O$	2504	712.7	"

100 grams of a saturated solution of zinc chloride in furfural contain 20.6 gms. $ZnCl_2$ at 25°. (Trimble, 1941)

IO ZINC IODATE $Zn(IO_3)_2$

SOLUBILITY OF ZINC IODATE IN WATER - DIOXANE MIXTURES AT 25°
(Ricci and Nesse, 1942)

Wt. % Dioxane in Solvent	$Zn(IO_3)_2$ Gms. per 100 gms. Sat. Sol.	$Zn(IO_3)_2$ Moles per liter Sat. Sol.	Wt. % Dioxane In Solvent	$Zn(IO_3)_2$ Gms. per 100 gms. Sat. Sol.	$Zn(IO_3)_2$ Moles per liter Sat. Sol.
0	0.6410	0.01548	60	0.0090	0.00022
10	.3746	.00910	70	.0030	.000075
20	.2301	.00562	80	.0017	.000042
30	.1158	.00285	90	.0008	.000019
40	.0572	.00142	100	.0000	.00000
50	.0244	.000605			

O ZINC OXIDE ZnO

As part of a study of the system ZnO + Cr_2O_3, Huttig and Theimer, 1941 determined the solubility of mixtures of ZnO and Cr_2O_3 in dilute HCl and H_2SO_4 after heating at various temperatures.

OH ZINC HYDROXIDE $Zn(OH)_2$

Oka, 1940 found the solubility of zinc hydroxide to be 3.6×10^{-6} moles per liter by potentiometric titration.

S ZINC SULFIDE ZnS

The solubility product was calculated from thermochemical data by Kapustinsky, 1940 who found the value 7.4×10^{-27}. The calculated solubility in moles per liter are as follows:

pH	= 3	5	7	9	11
S	$= 8.3 \times 10^{-6}$	8.3×10^{-8}	1.2×10^{-9}	8.6×10^{-11}	8.6×10^{-12}

ZINC SULFATE $ZnSO_4$

SOLUBILITY OF ZINC SULFATE IN WATER
(Rohmer, 1940)

t°	Density	Gms. $ZnSO_4$ per 100 gms. Sat. Sol.	Solid Phase	t°	Density	Gms. $ZnSO_4$ per 100 gms. Sat. Sol.	Solid Phase
30	1.520	38.1	7	70	1.548	40.8	1
32	1.530	38.7	7	75	1.535	40.2	1
36	1.553	40.2	7	85	1.505	39.2	1
37.9	1.561	40.8	7 + 6	100	1.462	37.7	1
40	1.590	41.2	6	54.6	1.627	44.2	6 + 2*
45	1.589	42.2	6	56	1.624	44.3	2*
56	1.634	44.6	6*	60	1.623	44.2	2*
60	1.650	45.7	6*	65	1.623	44.2	2*
65	1.672	46.9	6*	70	1.623	44.2	2*
70	1.693	48.2	6*	75	1.623	44.2	2*
75	1.710	49.5	6*	63.4	1.662	46.5	6 + 4*
48.8	1.606	43.0	6 + 1	65	1.664	46.6	4*
56	1.588	42.2	1	70	1.674	47.3	4*
60	1.577	41.9	1	75	1.680	47.9	4*
65	1.560	41.4	1				

* = Metastable 7, 6, 4, 2, 1 refer to $NiSO_4 \cdot 7H_2O$, $\cdot 6H_2O$, $\cdot 4H_2O$, $\cdot 2H_2O$ and $\cdot H_2O$.

SOLUBILITY OF ZINC SULFATE IN WATER ABOVE 100°
(Benrath, 1941)

[Solid phase $ZnSO_4 \cdot H_2O$]

t°	Gms. $ZnSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $ZnSO_4$ per 100 gms. Sat. Sol.	t°	Gms. $ZnSO_4$ per 100 gms. Sat. Sol.
90	50	175	35	255	15
115	45	205	25	250	10
145	40	230	20	255	5

EQUILIBRIUM IN THE SYSTEM ZINC SULFATE - SULFURIC ACID - WATER
(Copeland and Short, 1940)

Gms. per 100 gms. Sat. Sol.		Solid Phase	Gms. per 100 gms. Sat. Sol.		Solid Phase
$ZnSO_4$	H_2SO_4		$ZnSO_4$	H_2SO_4	
Results at -4.5°			Results at 6°		
28.8	0.2	7	30.6	0.0	7
21.8	7.1	7	26.7	4.8	7
18.8	11.3	7	22.9	9.1	7
14.9	16.8	7	17.3	17.8	7
11.1	22.6	7	11.5	31.2	7
8.8	28.2	7	11.6	33.8	7
7.7	34.6	7	11.7	34.5	7 + 1
7.3	38.5	7	10.3	36.1	1
8.1	38.9	7 + 1	8.5	38.2	1
6.2	41.5	1	6.0	41.8	1
3.9	45.1	1	1.9	50.2	1
1.5	51.2	1	1.0	53.3	1
0.9	54.6	1	0.2	65.1	1
0.4	59.1	1	0.2	66.0	1

Data of Copeland and Short, 1940 (Con.)

Gms. per 100 gms. Sat. Sol. $ZnSO_4$	Gms. per 100 gms. Sat. Sol. H_2SO_4	Solid Phase
Results at 15°		
33.5	0.1	7
33.4	0.4	7
29.7	4.2	7
27.6	6.9	7
21.0	16.7	7
18.1	23.8	7
17.6	28.0	7 + 1
17.0	28.6	1
16.1	29.6	1
15.7	29.8	1
15.0	30.5	1
8.4	38.4	1
4.6	43.5	1
0.5	57.5	1
Results at 35°		
39.5	0.2	7
37.3	0.5	7
37.0	3.4	7
36.1	5.0	7
36.1	5.2	7 + 6
35.7	5.9	6
35.3	6.4	6
35.1	6.7	6
34.7	7.1	6
33.4	8.6	6
31.8	11.8	6
30.4	14.1	6 + 1
29.4	14.7	1
28.3	16.0	1
22.6	22.0	1
19.1	25.6	1
14.8	30.6	1
7.5	39.8	1
5.8	42.4	1
2.1	50.1	1
0.4	60.8	1

Gms. per 100 gms. Sat. Sol. $ZnSO_4$	Gms. per 100 gms. Sat. Sol. H_2SO_4	Solid Phase
Results at 25°		
36.8	0.1	7
29.6	9.8	7
26.4	16.4	7
25.6	18.2	7 + 6
25.1	18.7	6
24.3	20.5	6 + 1
22.4	22.3	1
20.0	24.9	1
18.1	27.0	1
13.3	32.8	1
2.2	50.1	1
0.7	57.9	1
.8	68.1	1
.8	74.0	1
.7	78.2	1
.2	87.0	1 + 0
.3	89.0	0
.2	91.8	0
.1	94.6	C
.1	95.5	C
.1	96.6	C
Results at 45°		
42.0	0.4	6
40.1	2.4	6
39.4	3.8	6
38.6	4.8	6
37.5	6.3	6 + 1
36.4	7.7	1
36.0	8.8	1
34.9	9.3	1
32.7	10.2	1
33.9	10.3	1
32.9	10.7	1
30.9	12.1	1
29.2	14.4	1
27.2	16.7	1
23.5	20.6	1
18.5	26.0	1
15.4	29.6	1
6.2	41.8	1
2.8	48.8	1
0.8	56.6	1
0.9	63.9	1

Data of Copeland and Short, 1940 (Con.)

Gms. per 100 gms. Sat. Sol. $ZnSO_4$	Gms. per 100 gms. Sat. Sol. H_2SO_4	Solid Phase
Results at 55°		
43.5	0.4	6
43.5	0.5	6
44.1	0.5	6
42.1	0.8	6 + 1
41.8	1.8	1
40.0	3.1	1
39.0	4.6	1
36.5	6.7	1
30.9	11.9	1
21.7	21.4	1
20.8	23.3	1
12.3	33.6	1
3.9	46.0	1
1.1	55.8	1
0.4	67.9	1
Results at 65°		
42.3	0.4	1
41.8	.4	1
41.6	.7	1
41.2	1.0	1
38.2	3.4	1
36.9	4.8	1
35.6	5.8	1
34.2	7.1	1
29.2	12.7	1
20.9	22.2	1
15.4	29.2	1
12.5	32.8	1
3.4	48.1	1
0.7	58.6	1
0.9	59.4	1
Results at 70°		
41.1	0.3	1
41.0	0.3	1
37.2	3.3	1
36.5	4.9	1
33.5	6.8	1
33.4	7.6	1
27.5	14.5	1
20.7	22.2	1
15.9	29.0	1
7.4	41.4	1
1.9	54.4	1

7 = $ZnSO_4 \cdot 7H_2O$ 6 = $ZnSO_4 \cdot 6H_2O$ 1 = $ZnSO_4 \cdot H_2O$

o = $ZnSO_4$ C = $ZnSO_4 \cdot H_2SO_4$

Activities in the system $ZnSO_4 - H_2SO_4 - H_2O$ were determined from vapor pressure and EMF measurements by Tarter, Newschwander, and Ness, 1941.

EQUILIBRIUM IN THE SYSTEM ZINC SULFATE - ZINC OXIDE - WATER AT 25°

(Copeland and Short, 1940)

Gms. per 100 gms. Sat. Sol. ZnO	Gms. per 100 gms. Sat. Sol. SO_3	Solid Phase
1.8	1.9	$3Zn(OH)_2 \cdot ZnSO_4 \cdot 4H_2O$
4.4	4.4	"
8.1	8.0	"
10.7	10.7	"
13.6	13.6	"
14.5	14.5	"
17.6	17.6	"
18.3	18.3	$3Zn(OH)_2 \cdot ZnSO_4 \cdot 4H_2O + ZnSO_4 \cdot 7H_2O$

EQUILIBRIUM IN THE SYSTEM ZINC SULFATE - ZINC OXIDE - WATER AT 18°
(Gromov, 1948)

Saturated Solution				Solid Phase
Wt. % $ZnSO_4$	Gms. Zn per liter	Density	pH	
34.0	198.0	1.440	5.25	$3ZnO \cdot ZnSO_4 \cdot xH_2O + ZnSO_4 \cdot 7H_2O$
24.7	183.8	1.390	5.46	$3ZnO \cdot ZnSO_4 \cdot xH_2O$
19.1	103.5	1.242	5.58	"
14.4	67.7	1.159	5.71	"
10.8	49.2	1.120	5.82	"
7.6	33.4	1.080	6.00	"
3.7	15.5	1.035	6.20	"
1.7	7.0	1.015	6.37	"
1.6	6.4	1.014	6.40	"
0.7	3.0	1.006	6.52	"
0.3	1.1	1.002	6.70	"
0.0	0.0	1.000	7.20	$Zn(OH)_2$

- Results in the Presence of $FeSO_4$ -

Gms. per liter Sat. Sol.		pH	
Zn	Fe		
178.6	2.08	$3ZnO \cdot ZnSO_4 \cdot xH_2O$	
132.5	2.03	"	
101.3	2.0	"	
65.8	1.94	"	
48.5	1.90	"	
31.9	1.88	"	
15.5	1.82	"	
7.0	1.77	"	

Basic ZINC SULFATE $ZnSO_4 \cdot 3Zn(OH)_2$

The solubility product determined from potentiometric titration curves is 10^{-52}. (Nikurashin, 1938).

SO ZINC POTASSIUM SULFATE $ZnK_2(SO_4)_2 \cdot 6H_2O$

100 gms. of a saturated solution in water at 25° contain 11.72 gms. $ZnK_2(SO_4)_2$ (0.3873 moles per liter), and the density is 1.109. (Hill, Durham, and Ricci, 1940)

SO ZINC AMMONIUM SULFATE $Zn(NH_4)_2(SO_4)_2 \cdot 6H_2O$

100 gms. of a saturated solution in water at 25° contain 12.24 gms. $Zn(NH_4)_2(SO_4)_2$ (0.4601 moles per liter), and the density is 1.103. (Hill and Taylor, 1938)

SON ZINC SULFAMATE $Zn(SO_3NH_2)_2$

Cupery (1938) found the solubility to be 115 gms. per 100 gms. of water at 25°.

SeO

ZINC SELENATE $ZnSeO_4$

SOLUBILITY OF ZINC SELENATE IN WATER

(Klein, 1940)

t°	Density	Gms. $ZnSeO_4$ per 100 gms. Sat. Sol.	Gms. $ZnSeO_4$ per 100 gms. H_2O	Solid Phase
-2	-	17.4	21.0	Ice
-5.4	-	29.07	40.98	"
-7.8	-	32.17	47.42	Ice + $ZnSeO_4 \cdot 6H_2O$
0	1.4835	33.05	49.37	$ZnSeO_4 \cdot 6H_2O$
11.5	1.5201	35.34	54.65	"
22	1.5588	37.84	60.87	"
27	1.5796	39.5	65.2	"
34.4	-	41.8	71.8	"
28	-	40.5	68.0	"
29	-	40.8	68.9	$ZnSeO_4 \cdot 5H_2O$
40.3	-	43.1	75.7	"
43.4	1.6594	43.8	77.8	"
52	-	45.8	83.8	"
54.2	-	46.07	85.42	"
47	1.6250	42.95	75.20	$ZnSeO_4 \cdot H_2O$
56.2	1.5728	40.79	68.89	"
60	1.5611	40.44	67.89	"
52	1.6270	43.48	76.92	$ZnSeO_4$
60	1.5677	40.85	69.29	"
70	1.5061	38.29	62.05	"
80	-	35.63	55.35	"
91	-	33.4	50.1	"
98.5	1.3580	31.61	46.22	"

CNS

ZIRCONIUM THIOCYANATE $Zr(CNS)_4$

DISTRIBUTION OF ZIRCONIUM THIOCYANATE BETWEEN WATER AND ETHER

(Fischer and Chalybaeus, 1947)

A 0.5 N solution of HSCN containing $Zr(CNS)_4$ in ether was shaken with aqueous solutions of ammonium salts at room temperature. All data are in gms. per liter.

Water Phase Before Shaking		ZrO_2 After Shaking	
NH_4SCN	$(NH_4)_2SO_4$	Water Phase	Ether Phase
0	0	0.560	0.076
280	0	0.107	.155
0	10	1.160	.020
100	50	1.400	.010
200	50	1.300	.012
280	50	1.670	.038
0	100	3.800	.008
100	100	1.580	.010
280	100	3.500	.029

Cl **ZIRCONIUM OXYCHLORIDE $ZrOCl_2 \cdot 8H_2O$**

Results for the addition of concentrated sulfuric and nitric acids to this salt may be found under $Zr(SO_4)_2$ and $Zr(NO_3)_4$, below.

NO **ZIRCONIUM NITRATE $Zr(NO_3)_4$**

SOLUBILITY OF ZIRCONIUM NITRATE IN NITRIC ACID SOLUTIONS AT ROOM TEMPERATURE
(Paliuski, 1941)

The data were obtained by the addition of HNO_3 to $ZrOCl_2 \cdot 8H_2O$ in varying proportions. The mixtures were stirred at room temperature and atmospheric pressure and both solution and solid were analyzed.

Method of Preparation	Gms. per 100 gms. Sat. Sol.		Solid Phase
	HNO_3	ZrO_2	
10 g $ZrOCl_2 \cdot 8H_2O$ + 15.5 cc fuming HNO_3	59.4	14.8	$Zr(NO_3)_4 \cdot 6H_2O$
20 g " + 50 cc "	59.5	14.6	"
10 g " + 20 cc "	60.9	13.2	"
$Zr(OH)_4$ + HNO_3	62.4	13.0	"
$ZrOCl_2 \cdot 8H_2O$ + fuming HNO_3	63.0	12.4	$Zr(NO_3)_4 \cdot 5H_2O$
$Zr(OH)_4$ + HNO_3	64.9	11.9	"
	67.2	12.0	"
$ZrOCl_2 \cdot 8H_2O$ + fuming HNO_3	67.7	14.1	"
Concentrated Solution of $ZrO(NO_3)_2$ + Concentrated HNO_3	70.4	13.1	"
$Zr(NO_3)_4$ + HNO_3	70.8	12.8	2 Phases (?)
"	74	10.8	$Zr(NO_3)_4 \cdot HNO_3 \cdot 4H_2O$ (?)
"	76	10.5	2 Phases (?)
"	80	9.6	$Zr(NO_3)_4 \cdot 2HNO_3 \cdot 4H_2O$
"	83.3	8.06	"
"	84.8	8.58	"
"	86.9	9.23	$Zr(NO_3)_4 \cdot 2HNO_3 \cdot 3H_2O$ (?)

10 ml. of a saturated solution of zirconium nitrate in ether at 20° contain 0.4 mg. ZrO_2. (Wells, 1930)

NO **ZIRCONIUM OXYNITRATE $ZrO(NO_3)_2 \cdot 2H_2O$**

0.37 gms. $ZrO(NO_3)_2$ are dissolved in 100 gms. of a saturated solution in isoamyl alcohol at room temperature. Less than 0.1 gms. dissolve in methyl n-hexyl ketone under the same conditions. (Rothschild, Templeton and Hall, 1948).

O **ZIRCONIUM OXIDE ZrO_2**

Melting points in the system $ZrO_2 - CaCl_2$ are given by Belozersky and Kucherenko, 1940.

OH

ZIRCONIUM HYDROXIDE $Zr(OH)_4$

Oka, 1940 found the solubility to be 8.0×10^{-11} moles per liter by potentiometric titration.

SO

ZIRCONIUM SULFATE $Zr(SO_4)_2$

Data for the distribution of zirconium and hafnium sulfates between water and ether containing added ammonium sulfate and thiocyanic acid is given by Fischer and Chalybaeus, 1947.

SOLUBILITY OF ZIRCONIUM SULFATE IN WATER AND ZIRCONIUM OXIDE SOLUTIONS
(Palinski, 1941)

When zirconium sulfate is dissolved in water, the saturated solution contains 44.0 wt. % $Zr(SO_4)_2$ at 25° and 45.0% at 40°. The stable phase is $Zr(SO_4)_2 \cdot 4H_2O$. When much water is added to the salt, such that the solution contains less than about 19% $Zr(SO_4)_2$, the basic salt $7ZrO_2 \cdot 5SO_3 \cdot 30H_2O$ precipitates. The system was studied by varying the amounts of water added, and by a large number of dialysis experiments in which the products were separated, analyzed, etc. Prolonged boiling of moderately concentrated $Zr(SO_4)_2$ solutions precipitates $2ZrO_2 \cdot 3SO_3 \cdot 5H_2O$, and when there is a very large amount of water present, there is an indication of the formation of $2ZrO_2 \cdot SO_3 \cdot 7H_2O$. The results below are in grams per 100 gms. of saturated solution and the saturating phase is $7ZrO_2 \cdot 5SO_3 \cdot 30H_2O$.

Results at 25°				Results at 40°	
ZrO_2	SO_3	ZrO_2	SO_3	ZrO_2	SO_3
0.5	2.0†	24	19.3	11.9	11.1
2.0	4.4†	26.8	21.0	17.0	14.0
5.0	7.9†	28.0	21.1	20.5	16.6
7.0	9.6†	30.9	22.7	32.9	23.9
8.26	10.6	34.1	24.1	28.5	20.5
14.8	14.9	29.9	26.8	35.2	25.2
21.4	17.8	27.9	26.0	16.6	22.2*

† Estimated from the author's curve

* Solid phase $2ZrO_2 \cdot 3SO_3 \cdot 5H_2O$

SOLUBILITY OF ZIRCONIUM SULFATE IN SULFURIC ACID SOLUTIONS
(Palinski, 1941)

Varying amounts of sulfuric acid were added to $Zr(SO_4)_2 \cdot 4H_2O$ and up to two years were required to reach equilibrium, during which time the % ZrO_2 in solution fell continuously. The solid phases are similar to those found by Hauser (Vol. I, p. 1599) but the compositions of the saturated solutions differ somewhat. Additional data was obtained by adding sulfuric acid and oleum to $ZrOCl_2 \cdot 8H_2O$, in which cases the solid was changed to a sulfate.

Data of Falinski, 1941

Results at 25°

Gms. per 100 gms. Sat. Sol. ZrO_2	Gms. per 100 gms. Sat. Sol. SO_3	Solid Phase
20.7	27.1*	$Zr(SO_4)_2$
19.0	25.0*	$Zr(SO_4)_2 \cdot 4H_2O$
14.1	26.0	"
11.3	26.0	"
7.58	29.1	"
2.89	30.7	"
1.10	34.6	"
0.49	38.1	"
.19	43.2	"
.08	48.1	"
.05	53.1	"
.07	56.8	"
.13	59.9	"
.33	60.4	"
.54	63.2	"
1.53	63.6	"
2.08	63.8	$Zr(SO_4)_2 \cdot 4H_2O$ + $Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$
1.99	64.3	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$
0.91	66.4	"
.75	66.6	"
.72	67.8	"
.71	71.0	"
.81	72.0	"
.54	74.9	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot H_2O$
.50	75.9	"
.34	77.7	"
.02	79.9	$Zr(SO_4)_2 \cdot H_2SO_4$
.02	81.5	"
.02	83.1	"

Results at 40°

Gms. per 100 gms. Sat. Sol. ZrO_2	Gms. per 100 gms. Sat. Sol. SO_3	Solid Phase
20.2	26.5*	$Zr(SO_4)_2$
19.5	25.5*	$Zr(SO_4)_2 \cdot 4H_2O$
13.8	25.8	"
6.06	28.5	"
3.74	30.4	"
1.44	34.7	"
0.74	38.3	"
.13	47.1	"
.12	48.9	"
.08	53.0	"
.11	56.9	"
.65	62.4	"
1.51	63.8	"
2.2	64.2	$Zr(SO_4)_2 \cdot 4H_2O$ + $Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$
2.23	64.6	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$
1.35	65.9	"
1.0	67.7	"
1.12	71.3	"
1.18	73.0	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot H_2O$
0.19	75.6	$Zr(SO_4)_2 \cdot H_2SO_4$ (?)
.05	78.1	" (?)
.02	79.6	"
.03	80.8	"
.01	82.6	"

* No H_2SO_4 added

Results obtained by addition of H_2SO_4 to $ZrOCl_2 \cdot 8H_2O$ (Room temperature)

cc H_2SO_4 added per 10 gms. Salt	Gms. per 100 gms. Sat. Sol. ZrO_2	Gms. per 100 gms. Sat. Sol. SO_3	Solid Phase
12 "Ordinary Concentrated	0.51	61.4	$Zr(SO_4)_2 \cdot 4H_2O$
14 " Sulfuric"	3.0	62.4	Metastable (?)
15 "	2.2	63.3	"
16 "	2.0	63.7	$Zr(SO_4)_2 \cdot 4H_2O$ + $Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$
18 "	0.95	66.0	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$
20 "	.9	67.7	"
23 "	.75	69.3	"
24.5 "	.85	70.7	"
30 "	1.0	71.8	"
17 "Ac. Nordhausen"	1.2	72.1	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$ + $Zr(SO_4)_2 \cdot H_2SO_4 \cdot H_2O$
40 Ordinary Concentrated	0.88	72.5	$Zr(SO_4)_2 \cdot H_2SO_4 \cdot H_2O$
20 "Ac. Nordhausen"	.88	74.4	"
25 "	.7	75.8	"
30 "	.6	76.6	"
33 Oleum 18.9%	.24	78.6	"
20 " 60%	.24	79.1	$Zr(SO_4)_2 \cdot H_2SO_4$ (?)
43 " 18.9%	.03	80	"
40 "Ac. Nordhausen"	0.0	80.3	

CERRIC PHOSPHATE $Ce_2(PO_4)_3$

SOLUBILITY OF CERRIC PHOSPHATE IN AQUEOUS SOLUTIONS AT 100°

(Atanasiu and Rabor, 1938)

Cerric phosphate was precipitated from acid solution and the solubility determined under different treatments. Drying at 110° produced the salt $Ce_3(PO_4)_4 \cdot 11H_2O$.

Solvent	% solubility		
	Freshly precipitated	Dried at 100°	Ignited
water or 10% HAC	0	0	0
5% H_2SO_4	0.083	0.08	0
10% H_2SO_4	0.14	0.15	0
5% HCl	0.02	0.2	0
10% HCl	0.05	0.3	0
5% HNO_3	0.12	0.1	0
10% HNO_3	.18	.15	0
60% HNO_3	soluble	soluble	.1

CERRIC PYROPHOSPHATE $Ce\ P_2O_7$

SOLUBILITY OF CERRIC PYROPHOSPHATE IN HYDROCHLORIC ACID SOLUTIONS AT 20°

(Moeller and Schweitzer, 1948)

Radioactive pyrophosphate was added to an excess of cerric ion and the precipitated CeP_2O_7 was washed and dried. These samples were shaken for 36 hours with the acid solutions and then filtered off. The radioactive count in solution was used as the measure of the solubility. The data below were read from the curve drawn by the authors:

Normality of HCl	0.05	0.10	0.20	0.30
Moles CeP_2O_7 per liter:	1.1×10^{-4}	2.0×10^{-4}	3.2×10^{-4}	4.3×10^{-4}

CARBON Tetra BROMIDE CBr_4 (See also p. 85)

FUSION-POINTS OF MIXTURES OF CARBON Tetra BROMIDE AND PYRIDINE

(Davidson, Van der Werf, and Boatright, 1947)

The original results, except for eutectics and transition points are given only in the form of a diagram from which the following values were taken.

t°	Mol. % CBr_4	Solid Phase
-42.1	0.0	C_5H_5N
-43. (Eutectic)	2.8	$C_5H_5N + 3C_5H_5N \cdot CBr_4$
-30.	5.0	$3C_5H_5N \cdot CBr_4$
-20.	11.0	"
-17. (m. pt.)	18.0	"
-17.3 (tr. pt.)	19.0	$3C_5H_5N \cdot CBr_4 + 2C_6H_5N \cdot CBr_4$
-10.	25.0	$2C_5H_5N \cdot CBr_4$
- 8.5	30.0	"
- 7.8 (m. pt.)	33.0	"
-10.	40.0	"
-14. (Eutectic)	44.6	$2C_5H_5N \cdot CBr_4 + C_5H_5N \cdot CBr_4$
-12.5 (m. pt.)	48.0	$C_5H_5N \cdot CBr_4$
-10.	51.0	CBr_4
+10.	61.0	"
30.	72.0	"
47. (tr. pt.)	81.0	$CBr_4 + \alpha$ to β
50.	82.0	"
70.	90.0	"

CARBON Tetra CHLORIDE CCl_4 (See also p.85)

EQUILIBRIUM IN THE SYSTEM CARBON Tetra CHLORIDE - ACETIC ACID AND WATER AT 25°

(Siggia and Hanna, 1949)

The determinations were made by a method in which it was necessary to determine chemically only one of the three components. Mixtures of the two miscible components were titrated with the third component until turbidity appeared. The percentage of each component was calculated and the corresponding points plotted on a triangular diagram.

Gms. per 100 gms. of Mixture		
CH_3COOH	CCl_4	H_2O
86.0	10.3	3.46
77.0	18.7	4.21
67.8	30.6	1.56
52.2	47.1	0.72
76.3	4.04	19.70

SOLUBILITY OF CARBON Tetra CHLORIDE IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES

(Booth and Emerson, 1949)

Gms. Na Sulfonate per 100 gms. Aqueous Solvent	cc. CCl_4 per 100 cc. Aqueous Solvent in: Na Benzene Sulfonate		Na Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0.0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5.0	0.06	0.08	0.10	0.10	0.12	0.14	0.10	0.10
10.0	0.06	0.10	0.12	0.18	0.24	0.44	0.10	0.10
20.0	0.08	0.10	0.14	0.20	0.36	0.64	0.10	0.10
32.0	0.10	0.20	--	--	--	--	--	--
34.5	--	--	0.71	0.88	--	--	--	--
40.0	--	--	--	--	0.48	1.00	0.11	0.20

RECIPROCAL SOLUBILITY OF CARBON Tetra CHLORIDE AND PERFLUORO METHYL CYCLOHEXANE ($C_6H_{11}CF_3$)

(Hildebrand and Cochran , 1949)

The sealed tube method was used and the consolute temperatures observed during slow cooling of the mixtures.

t°	Volume Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of CCl_4	t°	Volume Fraction of $C_6H_{11}CF_3$	Mol. Fraction of CCl_4
3.0	0.909	0.953	25.2	0.400	0.574
17.5	0.833	0.910	19.9	0.286	0.447
23.4	0.769	0.870	14.4	0.231	0.377
25.5	0.714	0.834	4.0	0.167	0.288
26.8	0.600	0.752	8.0	0.091	0.168
26.7	0.500	0.669			

*Measured at 25°C

FUSION-POINTS OF MIXTURES OF CARBON Tetra CHLORIDE AND PYRIDINE

(Davidson, Van der Werf, and Boatright, 1947)

The following results, except for eutectics and melting-point, are given only in the form of a diagram from which the following values were taken.

t°	Mol. % CCl_4	Solid Phase
-42.0	0.0	C_5H_5N
-50.0	14.0	"
-55.0	20.0	"
-60.0	24.0	"
-63.8	26.7 (Eutec.)	$C_5H_5N + C_5H_5N \cdot 2CCl_4$
-60.0	30.0	$C_5H_5N \cdot 2CCl_4$
-50.0	42.5	"
-47.0	50.0	"
-42.6 (m. pt.)	66.0	"
-45.0	74.0	"
-47.9	78.4 (Eutec.)	$C_5H_5N \cdot 2CCl_4 + CCl_4$
-45.0	80.0	CCl_4
-32.0	90.0	"
-22.8	100.0	

Correction to Vol 2, 3rd Ed. Solubilities of Organic Compounds p. 6. The heading of the first table should be changed from Mutual Solubilities of, to Freezing-Points of Mixtures of Benzene and Carbon Tetra Chloride.

Freezing-Points of a mixture of Carbon Tetra Chloride and 2.6 Lutidine are given by Van der Werf, Davidson, and Michaelis, 1948.

Results for the densities and refractive indices of binary and ternary mixtures of Carbon Tetra Chloride, Ethyl Alcohol and Benzene at 25° are given by Campbell and Miller, 1947.

CARBON DISULFIDE CS_2 See also p. 101

Results for the composition of the liquid and vapor phases in the system Carbon Disulfide-Methyl Alcohol at 37.4° are given by Roberts and Mayer, 1941.

TRICHLORO MONOFLUORO METHANE CCl_3F

DICHLORO DIFLUORO METHANE CCl_2F_2

SOLUBILITY OF EACH SEPARATELY IN ORGANIC SOLVENTS AT 32.2°

(Copley, Zellhoeffer, and Marvel, 1939)

Solvent	Formula	Gms. CCl_3F per 100 gms. Solvent (1)	Gms. CCl_2F_2 per 100 gms. Solvent (1)
n Hexyl Alcohol	$C_6H_{13}OH$	28.7	29.1
Cyclohexanol	$C_6H_{11}OH$	22.9	17.0
Ethylene Glycol	$HOCH_2CH_2OH$	1.5	1.18
Trimethylene Glycol	$HOCH_2CH_2CH_2OH$	3.09	2.23
Cyclohexyl Methyl Ether	$C_6H_{11}OCH_3$	63.7	64.8
Anisole	$C_6H_5OCH_3$	41.5	37.8
Tetra Ethylene Glycol Dimethyl Ether	$CH_2O(CH_2CH_2O)_4CH_3$	31.2	22.3
Acetic Acid	CH_3COOH	25.1	31.0
Propionic Acid	C_2H_5COOH	42.0	46.7
Ethyl Laurate	$C_{11}H_{23}COOC_2H_5$	42.0	39.9
Ethyl Caprylate	$C_7H_{15}COOC_2H_5$	47.4	48.0
Heptaldehyde	$C_6H_{12}CHO$	53.4	52.5
Cyclohexanone	$C_6H_{10}O$	48.6	38.1
Acetyl Acetone	$CH_3COCH_2COCH_3$	40.0	38.6
Acetonyl Acetone	$CH_3COCH_2CH_2COCH_3$	24.7	18.5
Cyclohexyl Amine	$C_6H_{11}NH_2$	--	58.1
Anline	$C_6H_5NH_2$	11.3	6.04
Dimethyl Cyclohexyl Amine	$C_6H_{11}N(CH_3)_2$	64.0	57.6
Dimethyl Anline	$C_6H_5N(CH_3)_2$	38.2	26.2
Quinoline	C_9H_7N	22.9	11.9
N-Methyl Acetamide	$CH_3CONHCH_3$	25.6	18.1
N, N-Dimethyl Acetamide	$CH_3CON(CH_3)_2$	32.6	30.5
Valeronitrile	C_4H_9CN	--	47.0
Nitro Butane	$C_4H_9NO_2$	35.6	--
Ethyl Methyl Ketoxime	$C_2H_5(CH_3)C = NOH$	35.2	32.7
n Decane	$C_{10}H_{22}$	53.7	60.2
Mesitylene	$C_6H_3(CH_3)_3$	56.8	53.2
Bromo Benzene	C_6H_5Br	29.9	21.0
n Hexyl Bromide	$C_6H_{13}Br$	39.6	36.7

(1) At pressures equal to its vapor pressure at 4.5°

BROMOFORM $CHBr_3$

FUSION-POINTS OF MIXTURES OF BROMOFORM AND PYRIDINE

(Davidson, Van der Werf, and Boatright, 1947)

The following results, except for eutectics and melting-points are given only in the form of a diagram from which the following values are taken.

t°	Mol. % $CHBr_3$	Solid Phase	t°	Mol. % $CHBr_3$	Solid Phase
-42.	0.0	C_5H_5N	-45.3(m.pt.)	33.0	2:1
-48	10.0	"	-47	40.0	"
-54 (Eutec)	14.5	C_5H_5N + 3:1	-50.5	46.9	2:1 + $CHBr_3$
-51.7(m.pt.)	25.(1)	3:1	-40	52.0	$CHBr_3$
-52.2(tr.pt)	20.0	3:1 + 2:1	-20	65.0	"
-50.0	22	2:1	0	87.0	"

(1) By extrapolation 3:1 = $3C_5H_5N \cdot CHBr_3$ 2:1 = $2C_5H_5N \cdot CHBr_3$

Freezing-Points of mixtures of Bromoform and 2.6 Lutidine are given by Van der Werf, Davidson, and Michaelis, 1948.

CHLOROFORM $CHCl_3$

SOLUBILITY OF CHLOROFORM VAPOR IN WATER, BLOOD, SERUM, AND MILK

(Nicloux and Scatti-Foglieni, 1929)

Note - The determinations were made in an apparatus which permitted passing 180-200 liters of a mixture of air and 10-20 gms. of $CHCl_3$ vapor (corresponding to a $CHCl_3$ vapor tension of 8-16 mm. Hg) over 50 cc. of rapidly stirred water, blood, blood serum, blood plasma or milk, for about 30 minutes. Samples of the air-vapor mixture and of the saturated liquid were analyzed by mixing with alcohol, distilling, saponifying with sodium ethylate and titrating the resulting NaCl with silver nitrate solution. The quotient obtained by dividing the mgs. $CHCl_3$ per 100 cc. of the liquid phase by the mgs. $CHCl_3$ in 100 cc. of the air-vapor phase, reduced to 0° and 760 mm. pressure, is taken as the coefficient of solubility of chloroform vapor.

	Coefficient of Solubility of Chloroform vapor in:							
t°	H_2O	Human		Beef		Pork		Milk
		Blood	Serum	Blood	Serum	Blood	Serum	
13	12.9	18.9	12.2	18.5	17.0	27.3	14.6	--
20	7.7	--	--	17.5	17.6	25.0	13.7	76.4
25	7.0	--	--	10.2	--	--	--	--
30	6.2	15.3	12.5	9.7	9.3	15.9	9.6	38.1
37	3.8	10.3	9.1	8.1	7.4	14.0	8.9	26.9
40	3.5	--	--	--	--	--	--	--

RECIPROCAL SOLUBILITY OF CHLOROFORM AND PERFLUORO METHYL CYCLOHEXANE ($C_6H_{11}CF_3$)

(Hildebrand and Cochran, 1949)

The sealed tube method was used and the consolute temperatures observed during slow cooling of the mixtures.

t°	Volume Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of $CHCl_3$	t°	Volume Fraction of $C_6H_{11}CF_3$	Mol. Fraction of $CHCl_3$
26.3	0.909	0.960	50.1	0.500	0.708
41.0	0.833	0.916	49.0	0.400	0.618
46.6	0.769	0.890	38.6	0.231	0.422
48.9	0.714	0.858	28.9	0.167	0.327
50.2	0.600	0.784	7.2	0.091	0.195

*Measured at 25°C

FUSION-POINTS OF MIXTURES OF CHLOROFORM AND PYRIDINE

(Davidson, Van der Werf, and Boatright, 1947)

The following results, except for eutectics and melting-points, are given only in the form of a diagram from which the following values were taken.

t°	Mol. % $CHCl_3$	Solid Phase	t°	Mol. % $CHCl_3$	Solid Phase
-50	11	C_6H_5N	-70	62.0	$C_5H_5N \cdot CHCl_3$
-60	22	"	-76	70	"
-68.8*	30.3	$C_6H_5N + C_5H_5N \cdot CHCl_3$	-80.4	74.6	$C_5H_5N \cdot CHCl_3 + CHCl_3$
-67	40.0	$C_5H_5N \cdot CHCl_3$	-75	80	$CHCl_3$
-65.9**	50.0	"	-66.5	90	"

*(Eutectic) **(m.pt.)

Freezing-point data are given for mixtures of:

Chloroform + 2.6 Lutidine (Davidson, Van der Werf, and Boatright, 1947)
Chloroform + Dioxane (Kennard and McCusker, 1948)

IODOFORM CHI_3

FUSION-POINTS OF MIXTURES OF IODOFORM AND PYRIDINE

(Davidson, Van der Werf, and Boatright, 1947)

The following results, except for eutectics and melting-points, are given only in the form of a diagram from which the following values were taken.

t°	Mol. % CHI_3	Solid Phase	t°	Mol. % CHI_3	Solid Phase
-42	0	C_5H_5N	-20	21.5	CHI_3
-50.1*	10	$C_5H_5N + 3C_5H_5N \cdot CHI_3$	+20	28	"
-44 **	25***	$3C_5H_5N \cdot CHI_3$	60	33	"
-46 ****	20	$3C_5H_5N \cdot CHI_3 + {}^3CHI_3$	100	70	"

*Eutectic **(m. pt.) ***By extrapolation ****(tr. pt.)

Freezing-points of mixtures of Iodoform and 2.6 Lutidine are given by Van der Werf, Davidson, and Michaelis, 1948.

METHYLENE CHLORIDE CH_2Cl_2

Freezing-point data for mixtures of Methylene Chloride and Chlorine are given by Wheat II and Browne, 1940.

CYANAMIDE $CN \cdot NH_2$

The distribution coefficient of Cyanamide between Ethyl Ether and Water, reported as millimols per liter in ether divided by 50 millimols in water is 0.11 at room temperature (Collander, 1949, quoted from Collander and Bärlund, 1933).

FORMALDEHYDE HCOH

SOLUBILITY OF FORMALDEHYDE - DIMEDON CONDENSATION COMPOUND AT 25°

(Yoe and Reid, 1941)

Dimedon is the name given to 1.3 Cyclohexanedione, 5.5-Dimethyl.

100 cc. of aqueous buffer solution of pH 4.6 dissolve 0.0001 gm. Formaldehyde-Dimedon Compound.

100 cc. of aqueous buffer solution of pH 4.6 containing 0.008 gms. dimedon, dissolve 0.00005 gm. Formaldehyde-Dimedon Compound.

FORMIC ACID HCOOH

DISTRIBUTION OF FORMIC ACID BETWEEN WATER AND ORGANIC SOLVENTS

(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solution at about 26° and calculating the concentration of the latter by difference. The distribution coefficient K is the concentration of the H_2O layer (approx. 0.16%) divided by the concentration of the organic solvent layer. Results for K in :

$\frac{H_2O}{}$	$\frac{H_2O}{}$	$\frac{H_2O}{}$	$\frac{H_2O}{}$	$\frac{H_2O}{}$
n Butanol	Ethyl Acetate	Ether	Chloroform	Skellysolve B
1.2	1.7	3.1 - 2.8	10+	10+

Freezing-point data for mixtures of Formic Acid and Dioxane show no evidence of compound formation. The single eutectic is at approximately -40° and 42 percent formic acid. (Corwin and Naylor, Jr., 1947)

Freezing-point data for mixtures of Formic Acid and a series of Amines are given by Bastitch and Pushin, 1947.

In the case of binary mixtures of Formic Acid and with Phenylhydrazine, α and β Naphthylamine, Benzidine and Benzylamine an equimolecular compound is formed with each of the amines.

In the case of Diphenylamine two liquid layers are formed between 32 and 71 Mol. % Formic Acid.

In the case of Aniline a compound of 1 mol. Formic Acid and 2 mols. of Aniline is formed.

In the case of o and p Toluidine and of Dibenzylamine, compounds with Formic Acid are formed, each of which melts at a higher temperature than the melting points of the constituent members of the systems.

METHYL CHLORIDE CH_3Cl

SOLUBILITY OF METHYL CHLORIDE IN SEVERAL SOLVENTS

(Mamedaliev and Musachanly, 1940)

t°	Solvent	cc. CH_3Cl per 1.0 cc. Solvent: At t° and p. of Test	As Bunsen Coefficient	Corrected for solvent in Residual gas
10	Water	3.82	3.73	3.80
15	"	3.41	3.25	3.35
20	"	3.07	2.88	3.03
30	"	2.52	2.29	3.32
20	Benzene	48.58	45.41	47.23
20	Carbon Tetrachloride	39.28	36.94	37.56
20	Acetic Acid	39.28	36.68	36.70
20	Ethyl Alcohol	36.70	34.51	34.70

FREEZING-POINTS OF MIXTURES OF METHYL CHLORIDE AND CHLORINE

(Wheat II and Browne, 1940)

t°	Mol. % Cl_2	Solid Phase	t°	Mol. % Cl_2	Solid Phase
- 90	0.0	CH_3Cl	-122	49.0	$CH_3Cl \cdot Cl_2$
-100	11.2	"	-122	51.6	"
-114	21.6	"	-124	57.4	"
-119	25.8	"	-128	62.0	"
-124*	27.8	$CH_3Cl + (CH_3Cl)_2 \cdot Cl_2$	-129*	63.3	$CH_3Cl \cdot Cl_2 + Cl_2$
-123	28.3	$(CH_3Cl)_2 \cdot Cl_2$	-124	66.5	Cl_2
-120	34.6	"	-113	78.0	"
-122	41.0	"	-110	82.0	"
-125*	44.1	$(CH_3Cl)_2 \cdot Cl_2 + CH_3Cl \cdot Cl_2$	-102	100.0	"

* Eutectic

METHYL IODIDE CH_3I

The ratio of distribution of Methyl Iodide between Ethyl Ether and Water for concentrations of 817 millimols CH_3I per liter of $(C_2H_5)_2O$ layer and 9.75 millimols CH_3I per liter of H_2O layer is 84 at 21° (Collander, 1949.

FORMAMIDE $HCONH_2$

FREEZING-POINTS OF MIXTURES OF FORMAMIDE AND AMMONIA
(Sisler, Van der Werf, and Stephanou, 1946)

t°	Mol. % NH_3	Solid Phase	t°	Mol. % NH_3	Solid Phase
2.2	0	$HCONH_2$	-83.0	65.1	$NH_3 \cdot HCONH_2$
-14.0	10.4	"	-86.6	68.5	"
-19.8	22.6	"	-89.5	69.6	"
-33.9	33.5	"	-91.9	71.1	$2NH_3 \cdot HCONH_2$
-44.0	39.7	"	-93.0	75.4	"
-62.5	49.2	"	-96.0*	79.0	$2NH_3 \cdot HCONH_2 + NH_3$
-75.0**	53.4	$HCONH_2 + NH_3 \cdot HCONH_2$	-90.6	83.4	NH_3
-76	56.0	$NH_3 \cdot HCONH_2$	-83.2	91.9	"

** (tr.pt.) * (Eutec.)

The distribution coefficient of Formamide between Ethyl Ether and Water as reported in millimols per liter of ether layer divided by millimols per liter of water at 21° is 0.0014. (Bärlund, 1929).

NITRO METHANE CH_3NO_2

Correction, p. 36, Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, fourth line under **NITRO-METHANE** Change formula $C_6H_5NO_2$ to CH_3NO_2

METHANE CH_4

SOLUBILITY OF METHANE IN WATER
(Morrison and Billett, 1948)

Using an apparatus in which a liquid film was made to flow through the gas, the coefficient of solubility of methane in water was found to be 0.0279 at 25°.

PHASE EQUILIBRIA IN METHANE-n BUTANE SYSTEMS

The compositions and specific volumes of the coexisting phases of the Methane-n Butane system are given for the entire two phase region at temperatures above 70°F, by Sage, Hicks, and Lacey, 1940.

Results for the system Methane-n Butane in the gaseous and liquid regions are given by Sage, Bundenholzer, and Lacey, 1940.

The volumetric behavior of four experimental mixtures of Methane and n Butane was explored at seven temperatures from 100°F to 460°F and at pressures from near 400 to 10,000 pounds per square inch absolute, by Reamer, Korpi, Sage, and Lacey, 1947.

Phase behavior of the ternary system Methane-n Butane - Decane, at temperatures between 100°F and 460° and at pressures up to 10,000 pounds per square inch absolute are given by Reamer, Sage, and Lacey, 1947; results at 160°F and pressures from 1000 to 4000 pounds per square inch are given by Reamer, Fiskin, and Sage, 1949.

Phase Equilibria and phase behavior of the Methane-iso-Butane system at temperatures between 100°F and 460°F and at pressures up to 5,000 pounds per square indh is given by Olds, Sage, and Lacey, 1942.

PHASE EQUILIBRIA IN THE METHANE - PENTANE SYSTEM

The bubble-point and dew point pressures, the specific volumes and compositions of the Methane-Pentane system, at temperatures between 100°F and 460°F and pressures up to 5,000 pounds per square inch, are given by Sage, Reamer, Olds, and Lacey, 1942.

Results for equilibrium conditions of temperature, pressure and composition of the liquid and vapor phases of the system Methane-Pentane, calculated for regular intervals of molecular percentage, by means of a method of reduction to straight lines, are given by Othmer and Gilmont, 1948.

PHASE EQUILIBRIA IN THE METHANE - BENZENE SYSTEM

Results for the solubility of Methane in Benzene calculated from the experimental data obtained with a special apparatus, for the determination of the P - V - T - X relations at 100.27°F and pressures up to 400 atmospheres are given by Schoch, Hoffmann, Kasperick, and Mayfield, 1940

PHASE EQUILIBRIA IN THE METHANE - CYCLOHEXANE SYSTEM

Results for the solubility of Methane in Cyclohexane using a special apparatus for the determination of the P - V - T - X relations at 100.27°F 160°F and 220°F, 160°F and 220°F and pressures up to the critical, are given by Schoch, Hoffmann, and Mayfield, 1940.

PHASE EQUILIBRIA IN THE METHANE-n HEXANE SYSTEM

Results for the solubility of Methane in Hexane using a special apparatus for the determination of the P - V - T - X relations at 100.27°F, 160°F and 220°F and pressures up to the critical, reported in the form of bubble-point data are given by Schoch, Hoffmann, and Mayfield, 1941.

PHASE EQUILIBRIA IN THE METHANE-n HEPTANE SYSTEM

The densities and compositions of both phases in the Methane-n Heptane solubility equilibrium are given in tables and diagrams for 25°, 55°, and 85°C at total pressures from 35 to 250 atmospheres, by Boomer, Johnson, and Piercey, 1938.

PHASE EQUILIBRIA IN THE METHANE - DECANE SYSTEM

The specific volumes and compositions of the gas phase were determined for five mixtures of Methane and Decane at temperatures between 100°F and 460°F and pressures up to 10,000 pounds per square inch, and from these data the specific volumes, bubble-point pressures and properties of the co-existing phases were established by Reamer, Olds, Sage, and Lacey, 1942.

SOLUBILITY OF METHANE AT HIGH TEMPERATURES AND PRESSURES

(Ipatieff and Monroe, 1942)

The determinations were made in a rotating bomb. The methane contained 4% Nitrogen and Goeckel index of 1.01

t°	Atmospheres Pressure (guage)	Gms. CH_4 per 100 gms. C_6H_6	t°	Atmospheres Pressure (guage)	Gms. CH_4 per 100 gms. C_6H_6
100	30	1.3	175	42	1.55
	70	3.4		86	4.0
	98	4.8		118	6.7
	102	5.1		131	8.2
125	33	1.35	200	49	1.75
	72	3.4		95	4.6
	102	5.0		133	8.5
	112	6.0		141	9.6
150	38	1.4	225	57	2.1
	79	3.65		103	5.55
	108	5.7		152	11.9
	121	7.0	250	70	2.7
				116	7.9

A series of determinations at constant pressures showed that changes in temperature affect the solubility very little, especially at the lower temperatures.

METHYL ALCOHOL CH_3OH

RECIPROCAL SOLUBILITY OF METHYL ALCOHOL, METHYL METHACRYLATE AND WATER

(Kooi, 1949)

The sealed tube method was used. From a long series of determinations of the temperatures of appearance of turbidity in prepared mixtures of the three components, the compositions at selected temperatures were calculated by the method of least squares and the corresponding curves were drawn. Density determinations at 25° were made of mixtures corresponding to selected points on the curve. By means of these the composition of coexisting phases were determined. The critical solubility point at 25° is situated at 32.45 wt. % methyl alcohol, 38.50 wt. % methyl methacrylate and 29.05 wt. % water.

Composition in Wt. % of Points on the Solubility Curves

At 0°			At 25°			At 50°		
H_2O	CH_3OH	MM	H_2O	CH_3OH	MM	H_2O	CH_3OH	MM
4.65	12.61	82.74	6.17	12.41	81.42	7.69	12.21	80.10
10.59	20.94	68.47	12.76	20.42	66.82	14.94	19.90	65.16
15.85	26.45	57.70	18.97	25.45	55.58	22.09	24.45	53.46
21.82	32.24	45.94	25.85	30.60	43.55	29.88	28.96	41.16
27.62	36.33	36.05	32.09	34.08	33.83	36.56	31.83	31.61
31.54	39.28	29.18	36.76	36.27	26.97	41.98	33.26	24.76
36.07	40.40	23.53	41.45	37.00	21.55	46.83	33.60	19.57
40.69	41.70	17.61	47.3	37.04	15.66	53.91	32.38	13.21
43.74	42.25	14.01	51.77	36.20	12.03	59.80	30.15	10.05
58.10	37.90	4.00	55.98	34.95	9.07	53.85	32.00	14.15
64.52	32.20	3.28	62.63	31.18	6.19	60.76	30.16	9.08
71.94	27.25	0.81	69.91	26.45	3.64	67.88	25.65	6.47
80.3	19.1	0.4	78.9	18.7	2.4	77.9	18.1	4.0
90.	10.	0.0	88.9	10.0	1.1	87.4	9.8	2.8

Composition of Coexisting Phases at 25° in Wt. %

Upper Layer				Lower Layer			
$d\ \frac{25}{25}$	H_2O	CH_3OH	MM	$d\ \frac{25}{25}$	H_2O	CH_3OH	MM
0.9404	0.3	1.7	98.0	0.9898	93.1	6.2	0.7
0.9387	1.1	3.1	95.8	0.9775	85.0	13.5	1.5
0.9360	2.0	5.0	93.0	0.9636	75.2	21.9	2.9
0.9336	3.0	6.5	90.5	0.9535	67.4	28.0	4.6
0.9303	4.5	10.0	85.5	0.9420	58.4	33.6	8.0
0.9251	9.1	15.4	75.5	0.9299	47.7	36.6	15.7
0.9232	12.5	20.0	67.5	0.9264	43.6	36.7	19.7
0.9218	17.5	25.5	55.5	0.9228	37.5	35.5	27.0

MM = Methyl Methacrylate

DISTRIBUTION OF METHYL ALCOHOL BETWEEN WATER AND ORGANIC SOLVENTS AT 20°

(Samarokov and Klinskikh, 1949)

Results for:

H_2O + Ethyl Ether gms. CH_3OH per 100 cc		H_2O + Ethyl Acetate gms. CH_3OH per 100 cc		H_2O + Butyl Acetate gms. CH_3OH per 100 cc	
H_2O Layer	Ether Layer	H_2O Layer	Ethyl Acetate Layer	H_2O Layer	Butyl Acetate Layer
0.70	0.07	0.72	--	3.72	--
1.34	0.21	1.55	--	6.88	0.06
2.52	0.57	2.94	0.04	9.75	0.13
5.06	1.10	5.65	0.43	12.87	0.32
9.89	2.51	9.69	2.96	19.71	0.93
14.34	5.03	13.12	6.05	22.64	2.88
17.56	7.81	15.02	10.74		

The ratio of distribution of Methyl Alcohol between Ethyl Ether and Water for concentrations of 274 millimols per liter of ether layer divided by 1920 millimols per liter of water layer is 0.14 at 20° (Collander, 1949).

EQUILIBRIUM IN THE SYSTEM METHYL ALCOHOL, CHLORO BENZENE AND WATER AT 25°

(Siggia and Hanna, 1949)

The determinations were made by a method in which it was necessary to determine chemically only one of the three components. Mixtures of the two miscible components were titrated with the third component until turbidity appeared. The percentage of each component was calculated and the corresponding points plotted on a triangular diagram.

Gms. per 100 gms. of Mixture		
CH_3OH	C_6H_5Cl	H_2O
70.0	4.60	25.68
78.8	10.7	10.30
60.5	34.0	5.6
52.3	41.9	5.7
31.9	65.9	2.3
83.2	1.67	15.2
75.3	19.5	5.2

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 53, first table, change heading from Reciprocal Solubility etc. to Solubility of Solid Benzene in Methyl Alcohol.

SOLUBILITY OF METHYL ALCOHOL IN COMPRESSED GASES

(Kritchewsky and Karolewa, 1941)

Pressure in Atms.	Hydrogen: Mol. fraction $CH_3OH \times 10^3$ at: 25°	50°	75°	Pressure in Atms.	Carbon Dioxide: Mol. fraction $CH_3OH \times 10^3$ at: 25°	50°	75°
25	6.85	22.5	43.9	25	10.3	29.8	65.5
50	3.95	11.0	33.2	30	--	27.0	61.4
75	2.62	8.2	23.8	40	--	23.5	53.0
100	1.85	6.8	19.9	50	8.72	21.8	47.6
150	1.30	5.0	15.1	60	--	21.4	44.8
200	1.05	4.0	12.4	70	--	22.5	43.7
250	--	--	10.5	80	--	25.0	44.8
300	--	--	9.2	85	--	28.7	47.3
				90	--	33.0	--

Pressure in Atms.	Nitrogen: Mol. Fraction $CH_3OH \times 10^3$ at: 0°	25°	50°	75°	Methane: Mol. Fraction $CH_3OH \times 10^3$ at: 0°	25°	50°	75°
25	--	6.90	23.6	--	2.10	--	25.2	68.2
50	--	4.40	14.0	--	1.60	5.00	18.0	39.0
75	--	3.20	10.3	--	1.20	4.40	14.8	32.8
100	--	2.40	8.2	22.1	1.20	4.20	13.2	29.4
150	0.70	1.80	6.5	19.2	1.60	4.50	12.2	27.4
200	0.70	1.70	6.1	18.0	2.40	6.10	13.2	28.9
300	0.80	1.90	6.3	17.4	5.50	11.4	20.4	38.1
400	1.10	2.40	6.8	17.6	10.0	18.0	30.2	48.4
500	1.30	2.90	7.5	18.0	--	--	--	58.4
600	1.50	3.50	8.2	18.6	--	--	--	68.8
700	1.50	4.10	8.9	19.4	--	--	--	79.2

SOLUBILITY OF METHYL ALCOHOL IN SEVERAL SOLVENTS AT 4.5°

(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Solvent	Mol. Fraction CH_3OH in sat. sol.	Solvent	Mol. Fraction CH_3OH in sat. sol.
Triethylene tetramine	0.605	N, N-Dimethyl acetamide	0.369
Methylated triethylene tetramine I	0.588	N Methyl acetamide	0.297
Methylated triethylene tetramine II	0.523	Adiponitrile	0.109
Triacetyl trimethyl triethylene tetramine	0.520	Sebaconitrile	0.114
Hexamethylene diamine	0.578	Ethylene Glycole	0.188
		Triethyl phosphate	0.390
		n Tributyl borate	0.186

Vapor-Liquid equilibrium diagrams and numerical data are given for the following systems:

Methyl Alcohol + Acetone + Water (Griswold and Buford, 1949)
Methyl Alcohol + iso Butyl Alcohol + Water (Jänecke, 1950)
Methyl Alcohol + Methyl Acetate + Water (Crawford, Edwards, and Lindsay, 1949)

Methyl Alcohol + Glycol Monomethyl Ether (Simonetta and Barakan, 1947)

FREEZING-POINTS OF MIXTURES OF METHYL ALCOHOL, ETHYLENE GLYCOL AND WATER

(Conrad, Hill, and Ballman, 1940)

Results for the binary mixtures:

$H_2O + CH_3OH$		$H_2O + CH_2OH\ CH_2CH$	
Wt. % CH_3OH	t°	Wt. % CH_2OHCH_2OH	t°
10	-6.8	10	-3.6
20	-15.3	20	-8.3
25	-20.7	30	-14.4
30	-26.3	35	-18.2
35	-33.0	40	-22.6
40	-39.7	50	-34.6
50	-54.9	60	-49.3
		100	-13.5

Results for the ternary mixtures:

Wt. % CH_3OH in Mixture with CH_2OHCH_2OH	t° of Freezing of Ternary Mixtures Composed of H_2O and the following wt. percents of the mixtures of $CH_3OH + CH_2OHCH_2OH$				
	10	20	30	40	50
0.0	-3.6	-8.3	-14.4	-22.6	-34.6
21.9	-4.2	-9.6	-16.1	-25.4	-37.9
35.0	-4.8	-10.2	-17.7	-28.0	-41.6
42.0	-5.0	-10.8	-18.9	-29.4	-44.1
50.4	-5.5	-11.7	-20.1	-31.1	-46.5
50.8	-5.7	-12.2	-21.0	-32.3	-47.7
70.2	-5.9	-12.9	-22.0	-33.6	-49.6
78.6	-6.3	-13.8	-23.6	-35.4	-52.0
87.9	-6.5	-14.8	-25.0	-37.9	-54.0
100.0	-6.8	-15.3	-26.3	-39.7	-54.9

FREEZING-POINTS OF MIXTURES OF METHYL ALCOHOL AND ETHYLENE DIAMINE

(Elgort, 1936)

t°	Content of $C_2H_4(NH_2)_2$		Solid Phase	t°	Content of $C_2H_4(NH_2)_2$		Solid Phase
	Wt. %	Mol. %			Wt.%	Mol. %	
-97	0.0	0.0	CH_3OH	-39.5	56.2	40.0	$C_2H_4(NH_2)_2$
-99	5.5	2.9	"	-30.5	62.0	46.5	"
-101.5	10.4	5.8	"	-25.0	65.5	50.4	"
-106(Eutec)		8.5	CH_3OH + 2:1	-20.0	67.8	52.8	"
-100.5	17.4	10.1	2:1	-15.0	71.0	56.7	"
-77.0	25.0	15.1	"	-7.5	77.6	65.0	"
-64.0	30.6	19.1	"	+ 1.0	86.5	77.2	"
-54.5	35.4	23.1	"	+ 4.5	91.5	84.9	"
-48.8	44.3	29.7	"	7.5	95.5	92.3	"
-47.5*	44.8	33.8	2:1 + $C_2H_4(NH_2)_2$	8.5	100.0	100.0	"

*Tr. pt.

2:1 = $2CH_3OH \cdot C_2H_4(NH_2)_2$

Freezing-Point data for mixtures of Methyl Alcohol and Propionaldehyde are given by McKenna, Tartar, and Lingafelter, 1949.

UREA (Carbamide) $CO(NH_2)_2$

SOLUBILITY OF UREA IN WATER
(Kakinuma, 1941)

t°	Mol. Fraction $CO(NH_2)_2$ in saturated solution	t°	Mol. Fraction $CO(NH_2)_2$ in saturated solution
60	0.4338	85	0.5843
65	0.4610	90	0.6190
70	0.4903	95	0.6542
75	0.5204	100	0.6910
80	0.5517		

SOLUBILITY OF UREA IN AQUEOUS SOLUTIONS OF PHENOL AT 20°
(Campbell and Campbell, 1940)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
C_6H_5OH	$CO(NH_2)_2$		C_6H_5OH	$CO(NH_2)_2$	
0.0	49.8	$CO(NH_2)_2$	8.2	33.7	$CO(NH_2)_2 \cdot 2C_6H_5OH$
7.85	46.8	" (?)	10.15	22.2	"
8.5	46.9	$CO(NH_2)_2$ + 1:2	11.6	17.8	"*
9.3	45.3	1:2	14.35	15.15	"*
8.7	44.0	"	51.9	12.8	"
7.7	40.2	"	70.7	7.95	"
7.5	38.2	"	86.8	2.5	" + C_6H_5CH
7.9	34.6	"	84.5	0.0	C_6H_5OH

*In presence of two liquid layers 1:2 = $CO(NH_2)_2 \cdot 2C_6H_5OH$

SOLUBILITY OF UREA IN AQUEOUS SOLUTIONS OF RESORCINOL AT 23°
(Cohen - Adad, 1949)

Gms. per 100 gms. sat. sol.		Solid Phase	Gms. per 100 gms. sat. sol.		Solid Phase
$CO(NH_2)_2$	$C_6H_4(OH)_2$		$CO(NH)_2$	$C_6H_4(OH)_2$	
53.2	0.0	$CO(NH_2)_2$	13.7	38.7	1:1
51.3	6.6	"	11.5	48.6	"
50.2	13.3	"	9.2	53.7	"
44.85	13.45	1:1	7.4	64.0	"
30.55	17.85	"	4.8	63.5	$C_6H_4(OH)_2$
23.3	22.6	"	0.0	61.9	"

1:1 = $CO(NH_2)_2 \cdot C_6H_4(OH)_2$

FREEZING-POINTS OF MIXTURES OF UREA AND RESORCINOL
(Cohen - Adad, 1949)

t°	Gms. $C_6H_4(OH_2)$ per 100 gms. Mixture	Solid Phase	t°	Gms $C_6H_4(OH)_2$ per 100 gms. Mixture	Solid Phase
113.4	28.0	$CO(NH_2)_2$	102.7	64.7	1:1
104.8	35.0	"	87.7	85.2	1:1 + $C_6H_4(OH)_2$
100.2	39.0	"	89.3	86.0	$C_6H_4(OH)_2$
94.0	43.0	"	96.2	90.0	"
92.4	44.7	" + 1:1	101.7	94.0	"
93.4	46.0	1:1	109.5	100.0	

1:1 = $CO(NH_2)_2 \cdot C_6H_4(OH)_2$

Freezing-Points of mixtures of Urea and Water and of Resorcinol and Water which agree satisfactorily with previously published results are also given by Cohen - Adad, 1949.

FREEZING-POINTS OF MIXTURES OF THE DOUBLE COMPOUND 1:1 ($CO(NH_2)_2 \cdot C_6H_4(OH)_2$) AND WATER
(Cohen - Adad, 1949)

t°	Gms. $CO(NH_2)_2 \cdot C_6H_4(OH)_2$ per 100 gms. Mixture	Solid Phase	t°	Gms. $CO(NH_2)_2 \cdot C_6H_4(OH)_2$ per 100 gms. Mixture	Solid Phase
-1.78	8.50	ice	25.88	51.0	1:1
-3.56	17.00	"	33.84	59.5	"
-4.22	20.30	ice + 1:1	42.98	68.0	"
-5.27	25.50	" (unsta-	53.80	76.5	"
+2.33	25.50	1:1 ble)	67.52	85.0	"
11.24	34.00	"	85.46	93.5	"
18.55	42.50	"			

FREEZING-POINTS OF THE TERNARY SYSTEM UREA, RESORCINOL AND WATER
(Cohen - Adad, 1949)

t°	Gms. per 100 gms. sat. sol.		Solid Phase
	$CO(NH_2)_2$	$C_6H_4(OH)_2$	
-12.07	32.75	2.45	ice + $CO(NH_2)_2$
(-12.14	31.92	4.78)	ice + $CO(NH_2)_2$ + 1:1
-12.12	31.10	7.0	ice + 1:1
- 8.66	24.80	4.49	"
- 9.46	27.00	4.36	"
-10.24	29.00	4.24	"
(-12.14	31.1	7.0)	ice + 1:1 + $CO(NH_2)_2$
-11.05	31.00	4.12	ice + 1:1
- 5.72	1.00	37.13	ice + $C_6H_4(OH)_2$
- 6.12	2.00	36.75	"
- 6.30	2.45	37.50	"
- 6.66	2.48	36.55	ice + $C_6H_4(OH)_2$ + 1:1
- 6.46	3.00	36.82	ice + $C_6H_4(OH)_2$
(- 6.66	3.4	37.0)	ice + $C_6H_4(OH)_2$ + 1:1

Results in parentheses are given in text as the ternary eutectics.

The distribution coefficient of Urea between Ethyl Ether and water, reported in millimols per liter of ether layer divided by millimols (5000) per liter of water layer, is 0.00047 at 21° (Collander and Bärlund, 1933).

THIOUREA $CS(NH_2)_2$

The distribution coefficient of Thiourea between Ethyl Ether and water, reported in millimols per liter of ether layer divided by millimols (1000-2000) per liter of water layer, is 0.0063 at 22° (Bärlund, 1929).

METHYL AMINE CH_3NH_2

SOLUBILITY OF METHYL AMINE IN SEVERAL SOLVENTS AT 4.5°

(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Solvent	Mol. fraction CH_3NH_2 in Saturated Solution
Water	0.457
Ethylene Glycol	0.662
Glycerol	0.652
Diethylene Glycol	0.653

The ratio of distribution of Methyl Amine between Ethyl Ether and Water for concentrations of 2.2 millimols per liter of $(C_2H_5)_2O$ layer and 94 millimols per liter of the H_2O layer is 0.023 at 15° (Collander, 1949).

NITROAMINO GUANIDINE $NH_2NHC(NH)NHNO_2$

SOLUBILITY OF NITROAMINO GUANIDINE IN WATER AND IN 0.025 MOLAL SODIUM PHOSPHATE SOLUTIONS

(McBride, Henry, and Smith, 1949)

Note. The published paper reports the determinations only in the form of logarithmic equations and diagrams. At our request the authors have kindly supplied the following original numerical values from which their equations and diagrams were derived.

Solubility in Water				Solubility in 0.25 Molal Sodium Phosphate	
t°	Gms. $CH_5O_2N_5$ per 100 gms. H_2O	t°	Gms. $CH_5O_2N_5$ per 100 gms. H_2O	t°	Gms. $CH_5O_2N_5$ per 100 gms. H_2O
10	0.160	30	0.433	10	0.172
20	0.269	35	0.523	20	0.281
30	0.430	35	0.537	30	0.435
30	0.432	44.9	0.871	39.8	0.733
30	0.432	49.9	1.120	50.0	1.184
The pH range 5.84-6.98 at 30° for various solutions				The pH range 6.96-7.04 at 30° for various solutions	

SOLUBILITY OF NITROAMINO GUANIDINE AT 30° AS A FUNCTION OF pH

Solubility in Water				Solubility in 0.25 Molal Sodium Phosphate	
pH of Solution	Gms. $CH_5O_2N_5$ Per 100 gms. H_2O	pH of Solution	Gms. $CH_5O_2N_5$ per 100 gms. H_2O	pH of Solution	Gms. $CH_5O_2N_5$ per 100 gms H_2O
10.49	0.852	6.19	0.432	10.58	1.277
9.48	0.578	5.09	0.440	9.18	0.478
8.77	0.453	4.32	0.441	8.47	0.456
8.19	0.434	3.25	0.458	6.76	0.435
6.97	0.432	2.85	0.464	5.39	0.439
6.45	0.430	2.32	0.488	4.32	0.449
6.39	0.433	1.87	0.508		

AMINO GUANIDONIUM BISULFATE $NH_2C(:NH)NHNH_2 \cdot H_2SO_4$ (?)

SOLUBILITY OF AMINO GUANIDONIUM BISULFATE IN WATER AND IN AQUEOUS SULFURIC ACID SOLUTION

(Pitha and Smith, 1948)

The authors fail to give the formula of the compound used, and report their results only in the form of a diagram from which the following approximate values have been taken. At temperatures between 47° and 52° there are inflections in the solubility curves for which an explanation is not given.

t°	Gms. AG·H_2SO_4 per 100 gms. Solvent in:			t°	Gms. AG·H_2SO_4 per 100 gms. Solvent in:		
	H_2O	Aq. 0.7419 N H_2SO_4	Aq. 1.4088 N H_2SO_4		H_2O	Aq. 0.7419 N H_2SO_4	Aq. 1.4088 N H_2SO_4
5	10.0	5.5	4.5	40	36.5	31.0	27.0
10	12.5	8.5	7.0	47	53.0	40.0	36.0
20	18.5	12.5	10.5	50	54.0	45.0	41.0
25	22.0	16.0	14.0	52	59.0	45.0	41.0
30	25.0	20.0	17.5	60	77.0	61.0	53.0

TETRACHLORO ETHYLENE C_2Cl_4 See page 87

HEXACHLORO ETHANE CCl_3CCl_3

SOLUBILITY OF HEXACHLORO ETHANE IN ETHANE

(Halder and Maass, 1940)

An apparatus which permits solubility measurements in the critical temperature region was used. Samples could be removed from the upper and lower regions of the system without volume or pressure changes. Equilibrium was approached without stirring. Critical temperature, 44.85°

t°	Liquid Phase		Vapor Phase	
	Density	Gms. C_2Cl_6 per 100 gms. C_2H_6	Density	Gms. C_2Cl_6 per 100 gms. C_2H_6
40	--	20.64	--	2.76
40	0.300	20.51	0.149	2.63
42	--	--	0.174	4.26
43.5	0.267	18.35	0.177	6.05
44	0.253	16.77	0.184	6.68
45	0.246	14.77	0.204	8,86
46.5	0.239	14.37	0.224	10.42
50.05	--	--	0.228	13.05

Correction to Vol. 2, 3rd Ed. Solubilities of Organic Compounds. p. 66, eighth line under the heading Hexachloro Ethane, change critical solution temperature to demixing temperature.

TRICHLORO ACETIC ACID CCl_3COOH

The ratio of distribution of Trichloro Acetic Acid between Ethyl Ether and Water was found for concentrations of 79.5 to 1043 millimols acid per liter in ether divided by 18.8 to 105 millimols acid per liter in the water layer, to be 4.2-10 at room temperature. (Collander, 1949)

FREEZING-POINTS OF MIXTURES OF TRICHLORO ACETIC ACID AND ACETAMIDE

(Alibanskii, 1949)

The results are given mainly in the form of a diagram from which the following approximate values were read.

t°	Gm. mols. $CHCl_3COOH$ per 100 gm mols mixture	Solid Phase	t°	Gm. mols. $CHCl_3COOH$ per 100 gm mols mixture	Solid Phase
81	0.0	CH_3CONH_2	20.6	58.3	1:1 + 1:2
55	20.0	"	29.3	66.6	1:2
35	30.0	"	26	73.0	"
20	34.0	"	22.3	75.8	1:2 + $CHCl_3COOH$
14	35.88	CH_3CONH_2 + 1:1	35.0	80.0	$CHCl_3COOH$
20	40.0	1:1	50.0	90.0	"
26	50.0	"	58.3	100.0	"

1:1 = $CH_3CONH_2 \cdot CHCl_3COOH$ 1:2 = $CH_3CONH_2 \cdot 2CHCl_3COOH$

ACETYLENE CH:CH

SOLUBILITY OF ACETYLENE IN ETHYL BROMIDE AND IN ETHYL IODIDE

(Gand, 1945)

t°	p mm	cc C_2H_2 per 1.0 cc CH_3Br	t°	p mm	cc C_2H_2 per 1.0cc CH_3 I
25	256	5.46	19	646	3.42
			19.2	648	3.52
			20.0	469	3.13

PHASE EQUILIBRIA IN THE SYSTEM ACETYLENE - ETHYLENE - ETHANE

Diagrams and numerical data for the smoothed equilibrium vapor and liquid compositions of this system at 40°F and 60°F and at pressures from 464 to 764 pounds per square inch, are given by McCurdy and Katz, 1944.

SOLUBILITY OF ACETYLENE IN ACETONE

(Brameld and Clark, 1946)

A new gravimetric method of determination was used. In view of the extensive use of acetone as a solvent for acetylene in "dissolved acetylene" cylinders the results are expressed on the weight basis at a partial pressure of acetylene of one atmosphere, instead of the more frequently used volume coefficients.

t°	Milligrams C_2H_2 per 1.0 gm $(CH_3)_2CO$	t°	Milligrams C_2H_2 per 1.0 gm $(CH_3)_2CO$	t°	Milligrams C_2H_2 per 1.0 gm $(CH_3)_2CO$
-70	657	-30	152	10	53.5
-65	568	-25	127	15	46.4
-60	478	-20	112	20	39.4
-55	417	-15	95.1	25	32.7
-50	336	-10	81.6	30	30.0
-45	288	- 5	72.1	35	25.7
-40	217	0	68.7	40	24.4
-35	184	5	61.0		

The following results are also given for the solubility of Air in Acetone.

t°	Milligrams Air per 1.0 gm. $(CH_3)_2CO$	t°	Milligrams Air per 1.0 gm. $(CH_3)_2CO$
0	0.0222	25	0.01065
5	0.0200	30	0.00829
10	0.0177	35	0.00582
15	0.0154	40	0.00336
20	0.0130		

SOLUBILITY OF SOLIDIFIED ACETYLENE IN MIXTURES OF LIQUEFIED OXYGEN AND NITROGEN

(Ishkin and Burbo, 1939)

Vol. % O_2 in solvent	Temperature °K	Temperature °C	cc (0°, 760 mm) C_2H_2 per liter sat. sol.	Mol. fraction C_2H_2 in sat. sol.
99.6	90	-183	4.7	0.0000059
80	85.6	-187.4	4.08	0.0000054
55	82.0	-191	3.6	0.0000051
50	81.4	-191.6	3.5	0.0000050
0 (=N_2)	77.4	-195.6	2.78	0.0000046

ETHYLENE DICHLORIDE CHCl:CHCl

SOLUBILITY OF ETHYLENE DICHLORIDE IN AQUEOUS SOLUTIONS OF 3.5.5 TRIMETHYL HEXYL SODIUM SULFATE AT 25°

(Bruner, 1949)

Gms. 3.5.5 Trimethylhexyl Sodium Sulfate per 100 gms. aqueous Solvent	Gms. $C_2H_2Cl_2$ Dissolved per 100 gms. aqueous Solvent
5.0	less than 1.0
10.0	1.0
25.0	5.0

OXALIC ACID $(COOH)_2 \cdot 2H_2O$

SOLUBILITY OF OXALIC ACID IN FURFURAL

(Trimble, 1941)

Results for $(COOH)_2 \cdot 2H_2O$		Results for $(COOH)_2$	
t°	Gms. $(COOH)_2$ per 100 gms. sat. sol.	t°	Gms. $(COOH)_2$ per 100 gms. sat. sol.
0	3.2	0	1.6
25	4.8	25	3.6
40	9.1	40	7.8

DISTRIBUTION OF OXALIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the acid in the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration in the latter by difference. The distribution coefficient K is the concentration in the H_2O layer (approx. 0.16%) divided by the concentration in the organic solvent layer.

Results for K in:

H_2O / Butanol	H_2O / Ethyl Acetate	H_2O / Ethyl Ether	H_2O / Chloroform	H_2O / Skellysalve
4.6-5.8	10+	10+	10+	10+

DICHLORO ACETIC ACID $CHCl_2COOH$

The ratio of distribution ($\frac{\text{conc. ether}}{\text{conc. } H_2O}$) of Dichloro Acetic Acid between Ethyl Ether and Water was found for concentrations of 190-940 millimols of acid per liter of the ether layer to be 7.2-10 at 25°. (Collander, 1949, quoted from Dermer, Murkham, and Trimble, 1941).

BROMO, CHLORO and IODO ACETIC ACIDS $CH_2BrCOOH$ etc.

COEFFICIENT OF DISTRIBUTION OF BROMO, CHLORO AND IODO ACETIC ACID BETWEEN ETHYL ETHER AND WATER
(Collander, 1949)

t°	Acid	Millimols Acid per liter: Ether Layer	Millimols Acid per liter: H_2O Layer	Distribution Coefficient
25	$CH_2BrCOOH$	80-820	--	3.0-4.0
18	$CH_2ClCOOH$	57.1-795	26.0-290	2.2-2.7
20	CH_2ICOOH	608	84.5	7.2

FREEZING-POINTS OF MIXTURES OF CHLORO ACETIC ACID AND ACETAMIDE
(Alibanskii, 1949)

The results are given mainly in the form of a diagram from which the following approximate values were read.

t°	Gm. Mols. $CH_2ClCOOH$ per 100 gm. mols. Mixture	Solid Phase	t°	Gm. Mols. $CH_2ClCOOH$ per 100 gm. mols. Mixture	Solid Phase
81	0.0	CH_3CONH_2	10	60.	1:2
60	20.0	"	13.2	66	1:1 + $CH_2ClCOOH$
40	32.0	"	20.	70	$CH_2ClCOOH$
20	40.0	"	40	78	"
5.6	44.0	CH_3CONH_2 + 1:1	50	85	"
8.0	50.0	1:1	61.8	100	
4.7	55.0	1:1 + 1:2			

1:1 = $CH_3CONH_2 \cdot CH_2ClCOOH$. 1:2 = $CH_3CONH_2 \cdot 2CH_2ClCOOH$.

Correction to Vol 2, 3rd. Ed. Solubilities of Organic Compounds p. 92, in the sentence following the first table, change critical solution temperature to demixing temperature.

ACETONITRILE CH_3CN

The ratio of distribution of Acetonitrile between Ethyl Ether and Water was found for 376 millimols per liter of the ether layer divided by 624 millimols per liter of the water layer, to be 0.60 at 20° (Collander, 1949).

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 85 first table, remove Critical from the title and column headings.

NITRILE (Polymerizing) $(CH_3CN)_x$

SOLUBILITY OF POLYMERIZED NITRILE IN AQUEOUS POTASSIUM OLEATE SOLUTIONS AT 20°
(Yurzhenko and Mintz, 1945)

Percent Concentration of Potassium Oleate	Percent of $(CH_3CN)_x$ by Volume
0.75	16.2
1.50	16.7
3.00	17.3

CHLORAL HYDRATE $CCl_3CH(OH)_2$

The ratio of distribution ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) Chloral Hydrate between Ethyl Ether and Water was found for 766 millimols per liter of ether layer to be 4.3 at 20° (Collander, 1949).

ETHYLENE $CH_2:CH_2$

Using an apparatus in which a liquid film was made to flow through the gas, the solubility coefficient of Ethylene in water was found to be 0.1044 at 25° (Morrison and Billett, 1948).

SOLUBILITY OF ETHYLENE IN WATER, BLOOD AND SERUM
(Nicloux and Scotti-Foglieni, 1929)

The apparatus mentioned in the Note under Chloroform (p.572) was used. The ethylene was prepared by dehydrating alcohol at about 380° using kaolin as catalyser. The gas mixture had compositions corresponding to an ethylene partial pressure of 270 to 760 mm Hg. The samples of the gas mixture and saturated liquid were analyzed by a volumetric method previously described by Nicloux.

The Coefficient of Solubility is the volume of C_2H_4 in 100 cc of the liquid layer divided by the volume in 100 cc of the gas mixture, corrected to 0° and 760 mm. pressure.

Coefficient of Solubility of Ethylene in:

t°	H_2O	Blood of		Serum of	
		Beef	Pork	Beef	Pork
20	0.108	0.154	0.190	0.106	0.108
30	0.088	0.117	0.147	0.085	0.085
40	0.073	0.088	0.105	0.069	0.070

PHASE EQUILIBRIUM IN THE SYSTEM ETHYLENE - PROPYLENE

Diagrams and numerical data for the densities and molecular compositions of the vapor and liquid phases in the critical temperature region are given by Schneider and Maass, 1941. The critical temperature of the 1:1 Ethylene Propylene System was found to be 58.3° ± 0.05 C and the critical density, 0.230 gm. per cc.

PHASE EQUILIBRIUM IN THE SYSTEM ETHYLENE - n HEPTANE

Diagrams and numerical data for the P - V - T - X relations of the liquid - vapor phase boundaries of the system Ethylene - n Heptane are given by Kay, 1948.

Freezing-point data for mixtures of Ethylene and Trimethyl Borine show the formation of the compound $3C_2H_2 \cdot 2(CH_3)_3B$ with eutectics at -175.8° and -176.05° and maximum for 40% $(CH_3)_3B$ at 175.05° (Chatt, 1949).

Correction to Vol. 2, 3rd. Ed. "Solubilities" p. 97, first table, change Xylol to Xylene and in the last line of first table, change Heavy Solvent to Light Solvent (b. pt. 61-90°).

SOLUBILITY OF ETHYLENE IN ETHYL ALCOHOL

(Carius, 1855)

The Ethylene was prepared from Ethyl Alcohol + H_2SO_4. The solvent Ethanol had a density of 0.792 at 20°. β = Bunsen Absorption Coefficient

Temp.	β	Temp.	β
0	3.595	15	2.883
5	3.323	20	2.713
10	3.086	25	2.578

SOLUBILITY OF ETHYLENE IN POLYSTYRENE AT 170°

(Newitt and Weale, 1948)

Atms. Pressure	cc C_2H_4 (0° 760 mm) per gm. Polystyrene
49.0	5.27
77.5	8.05
92.5	9.20-10.30

ETHYLENE BROMIDE $CH_2Br \cdot CH_2Br$

RECIPROCAL SOLUBILITY OF ETHYLENE BROMIDE AND WATER
(Shostakovsky and Druzhnin, 1942)

Results for:

t°	Ethylene Bromide in Water		Water in Ethylene Bromide	
	d.	Gms. $CH_2Br \cdot CH_2Br$ per 100 gms. sat. sol.	d.	Gms. H_2O per 100 gms. sat. sol.
0	1.012	0.25	--	--
25	1.021	0.36	2.200	0.54
35	1.022	0.42	2.197	0.63
50	1.035	0.54	2.183	1.18
75	1.049	0.77	2.179	1.83

DICYANO DIAMIDE (Guanidine 1-cyano) $NH_2C(:NH)NHCN$

The ratio of distribution of $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Dicyano Diamide between Ethyl Ether and Water was found for a concentration of 225 millimols per liter of the H_2O layer to be 0.0029 at 22° (Collander, 1949, quoted from Bärlund, 1929)

ACETALDEHYDE $H_3C \cdot CHO$

SOLUBILITY OF ACETALDEHYDE - DIMEDON CONDENSATION COMPOUND AT 25°
(Yoe and Reid, 1941)

Dimedon id the name given to 1, 3 Cyclohexanedione, 5, 5 dimethyl

100 cc of aq. buffer solution of pH 4.6 dissolve 0.0078 gm. Acetaldehyde - Dimedon compound.

100 cc of aq. buffer solution of pH 4.6 containing 0.008 gm. dimedon dissolve 0.0032 gm. Acetaldehyde - Dimedon compound.

CHLORO ACETAMIDE $CH_2ClCONH_2$

The coefficient of distribution of Chloro Acetamide between Ethyl Ether and Water for concentrations of 34.7 millimols per liter of the ether layer divided by 361 millimols per liter of the H_2O layer, is 0.096 at 20° (Collander, 1949).

ACETIC ACID CH_3COOH

MUTUAL SOLUBILITY OF ACETIC ACID, CAPROIC ACID AND WATER AT 25°

(Othmer and Serrano, Jr., 1949)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
CH_3COOH	$CH_3(CH_2)_4COOH$	CH_3COOH	$CH_3(CH_2)_4COOH$	CH_3COOH	$CH_3(CH_2)_4COOH$
0.0	94.5	35.0	23.0	47.8	6.2
4.0	90.0	37.0	20.0	48.0	5.0
12.2	78.0	39.5	16.5	47.8	4.2
22.0	58.0	41.3	14.0	47.0	3.3
29.0	39.0	43.3	12.0	45.0	2.5
30.5	33.0	45.0	10.3	30.0	1.5
32.6	28.4	46.8	8.2	17.0	1.2
33.5	26.0	47.6	7.2	0.0	1.1

Distribution of Acetic Acid Between Water and Caproic Acid

Gms. CH_3COOH per 100 gms.	
H_2O layer	$CH_3(CH_2)_4COOH$ layer
7.43	2.6
12.8	5.3
19.0	8.4
24.0	11.4
27.8	14.2
32.0	17.6
35.2	20.6
38.8	25.6
44.2	35.6
43.8	43.8*

Density of Conjugate Phases of the Acetic Acid Distribution

H_2O layer		$CH_3(CH_2)_4COOH$ layer	
d.	Wt. % CH_3COOH	d.	Wt. % CH_3COOH
1.00	0.0	0.929	0.0
1.004	6.5	0.9385	5.0
1.008	12.6	0.9525	13.9
1.012	19.7	0.964	20.0
1.0145	26.2	0.975	25.0
1.018	31.7	0.987	30.0
1.020	40.0	0.999	35.0
1.021	44.0	1.014	42.0
---	--	1.020	48.0
1.018	43.8*	1.018	43.8*

*Plait Point

MUTUAL SOLUBILITY OF ACETIC ACID, 2 ETHYL HEXOIC ACID AND WATER AT 25°

(Othmer and Serrano, Jr., 1949)

Gms. Per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
CH_3COOH	$CH_3(CH_2)_3 \cdot CH(C_2H_5)COOH$	CH_3COOH	$CH_3(CH_2)_3 \cdot CH(C_2H_5)COOH$	CH_3COOH	$CH_3(CH_2)_3 \cdot CH(C_2H_5)COOH$
0.0	98.8	51.0	30.0	47.5	2.0
8.0	90.0	54.6	23.0	45.0	1.8
10.5	87.2	56.0	19.0	38.0	1.0
21.0	75.0	57.0	15.0	25.0	0.5
33.0	59.0	57.0	12.0	18.6	0.4
40.0	48.8	56.5	8.5	17.3	0.3
46.0	39.0	55.5	6.5	0.0	0.15
49.0	34.0	51.6	3.4		

Distribution of Acetic Acid Between Water and 2 Ethyl Hexoic Acid

CH_3COOH per 100 gms.	
H_2O layer	$CH_3(CH_2)_3CH\cdot(C_2H_5)\cdot COOH$
7.0	2.0
15.0	4.0
20.8	6.0
25.6	7.9
30.0	9.5
34.0	11.2
37.1	12.7
40.8	14.5
46.0	17.6
49.8	20.8
52.7	25.6
54.5	30.8
56.0	37.0
54.0	54.0

Density of Conjugate Phases of the Acetic Acid Distribution

H_2O layer		$CH_3(CH_2)_3CH(C_2H_5)COOH$ layer	
d.	Wt. % CH_3COOH	d.	Wt. % CH_3COOH
1.00	0.0	0.9075	0.0
1.039	6.7	0.9122	4.0
1.089	15.0	0.920	8.5
1.014	25.0	0.927	13.0
1.02	37.0	0.938	20.5
1.023	46.0	0.955	31.0
1.023	50.0	0.976	40.0
1.019	55.0	0.988	45.0
1.012	57.	0.9975	49.3
1.010	53.5*	1.010	53.5*

*Plait Point

MUTUAL SOLUBILITY OF ACETIC ACID, 2 ETHYL BUTYRIC ACID AND WATER AT 25°

(Othmer and Serrano, Jr., 1949)

Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.		Gms. per 100 gms. sat. sol.	
CH_3COOH	$CH_3(CH_2)CH\cdot(C_2H_5)COOH$	CH_3COOH	$CH_3(CH_2)CH\cdot(C_2H_5)COOH$	CH_3COOH	$CH_3(CH_2)CH\cdot(C_2H_5)COOH$
10.0	96.3	33.2	26.0	34.5	4.6
11.7	80.5	34.6	20.0	25.6	3.0
22.8	62.8	35.3	16.1	12.3	1.5
20.6	62.0	35.6	13.5	4.0	0.4
25.8	48.0	36.5	12.5	0.0	0.25
30.0	36.7	35.0	11.6		

Distribution of Acetic Acid Between Water and 2 Ethyl Butyric Acid

Gms. CH_3COOH per 100 gms.	
H_2O layer	$CH_3(CH_2)CH\cdot(C_2H_5)COOH$
7.8	2.6
12.8	5.7
18.9	8.5
23.3	11.8
28.0	13.4
32.4	15.6
35.0	18.4
35.8	22.0
32.7	26.3
31.0	31.0*

Density of Conjugate Phases of the Acetic Acid Distribution

H_2O layer		$CH_3(CH_2)CH(C_2H_5)COOH$ layer	
d.	Wt. % CH_3COOH	d.	Wt. % CH_3COOH
1.000	0.0	0.9235	0.0
1.004	7.5	0.9322	6.2
1.008	15.5	0.9562	18.9
1.011	23.9	0.970	25.0
1.012	31.2	0.984	29.5
1.012	35.0	--	--
1.005	36.5	--	--
1.001	36.0	--	--
0.992	33.5	--	--
0.987	30.7*	0.987	30.8*

*Plait Point

RECIPROCAL SOLUBILITY OF ACETIC ACID AND TRIETHYL AMINE

(Van Klooster and Douglass, 1945)

Weighed mixtures of CH_3COOH and $(C_2H_5)_3N$ were warmed in sealed tubes until clear and then cooled and the temperature noted at which clouding appeared.

t° of clouding	Gms. CH_3COOH per 100 gms. Mixture	t° of clouding	Gms. CH_3COOH per 100 gms. Mixture
13.5	3.87 +	126.5	30.5
57.0	7.91	98.8	39.5
77.6	11.8	92.6*	40.0
92.6*	13.0	42.0	44.5
126.5	20.8	20.0	46.0 +

*non-variant equilibrium + limits of miscibility at 20°

The b.pts and compositions of the corresponding liquid and vapor phases are also given. The maximum critical solution temperature is at 130°C and 25 weight percent acetic acid.

EQUILIBRIUM IN THE SYSTEM ACETIC ACID, GLYCEROL AND BENZENE AT 25°

(Siggia and Hanna, 1949)

The determinations were made by a method in which it was necessary to determine chemically only one of the three components. Mixtures of the two miscible components were titrated with the third component until turbidity appeared. The percentage of each component was calculated and the corresponding points plotted on a triangular diagram.

Gms. per 100 gms. Mixture		
Glycerol	CH_3COOH	C_6H_6
45.0	50.4	4.63
33.7	61.5	4.74
24.0	67.0	9.03
9.68	71.9	18.5
5.16	66.6	28.4

DISTRIBUTION OF ACETIC ACID BETWEEN WATER AND ORGANIC SOLVENTS

(Marvel and Richards, 1949)

The determinations were made by titrating the acid in the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration in the latter by difference. The distribution coefficient K is the concentration in the water layer (approx. 0.16%) divided by the concentration in the organic solvent layer.

Results for K :

$\frac{H_2O}{}$	$\frac{H_2O}{}$	$\frac{H_2O}{}$	$\frac{H_2O}{}$	$\frac{H_2O}{}$
n Butanol	Ethyl Acetate	Ethyl Ether	Chloroform	Skellysolve B
0.91	1.5	2.3	10 +	10 +

The ratio of distribution $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of acetic acid between ethyl ether and water was found for concentrations between 20 and 200 millimols of acid per liter of the ether layer to be 0.48-0.52 at 20°. (Collander, 1949, quoted from the I. C. T.).

VAPOR - LIQUID EQUILIBRIUM IN THE SYSTEM ACETIC ACID - ACETONE - WATER

Diagrams and numerical data for vapor-liquid equilibrium compositions of the ternary and the corresponding binary systems for the boiling temperatures at 760 mm absolute pressure, are given by York and Holmes, 1942.

FREEZING-POINTS OF MIXTURES OF ACETIC ACID AND ACETAMIDE

(Alibanskii, 1949)

The results are given only in the form of a diagram from which the following approximate values were read.

t°	Gm. Mols. CH_3CONH_2 per 100 gm. mols. Mixture	Solid Phase	t°	Gm. Mols. CH_3CONH_2 per 100 gm. mols. Mixture	Solid Phase
81.	100	CH_3COONH_2	-12	32.0	1:1
50	68	"	-17**	28.5	1:1 + CH_3COOH
30	55	"	-10	25.0	CH_3COOH
-2.4*	48.5	CH_3COONH_2 + 1:1	0	18.0	"
-8	37.0	1:1	+10	5.0	"

1:1 = $CH_3CONH_2 \cdot CH_3COOH$ * = tr. pt. ** = Eutec.

FREEZING-POINTS OF MIXTURES OF ACETIC ACID AND p TOLUIDINE

(Lucasse, Koob, and Miller, 1944)

t°	Mol. % CH_3COOH	Solid Phase	t°	Mol. % CH_3COOH	Solid Phase
16.7	100.	CH_3COOH	49.1**	66.6	2:1
12.5	94.3	"	47.6	57.3	"
9.1	91.3	"	41.6	39.2	"
6.4*	89.7	CH_3COOH + 2:1	36.8	33.9	"
26.5	85.5	2:1	30.2*	28.6	2:1 + p $CH_3C_6H_4NH_2$
40.7	79.9	"	32.8	22.2	p $CH_3C_6H_4NH_2$
44.4	77.1	"	36.4	14.0	"
48.9	69.5	"	43.8	0.0	"

2:1 = $2CH_3COOH \cdot$ p $CH_3C_6H_4NH_2$ * = Eutec. ** = m. pt.

FREEZING-POINTS OF MIXTURES OF ACETIC ACID AND UROTROPINE

(Carroll and Wright, 1947)

t°	Wt. % CH_3COOH	Solid Phase	t°	Wt. % CH_3COOH	Solid Phase
16.5	100	CH_3COOH	19.2	72.0	3:13
12.0	89.3	"	24.8**	65.0	"
8.5	85.2	"	21.2	61.5	"
2.4*	81.0	3:13	19.4	60.0	"
2.6	80.0	"	18.0*	59.3	3:13 + $C_6H_{12}N_4$
14.2	75.0	"	26.0	58.0	$C_6H_{12}N_4$

3:13 = $(C_6H_{12}H_4)_3 \cdot (C_2H_4O_2)_{13}$ * = Eutec. ** = m. pt.

The system shows a marked tendency to supercool and the f. pt. diagram may easily be followed below the eutectic points. More than 42 percent urotropine can not be dissolved in acetic acid.

FREEZING-POINTS OF MIXTURES OF ACETIC ACID AND TRIMETHYL PHOSPHATE
(Pagel and Ruyle, 1948)

t°	Mol. % CH_3COOH	Solid Phase	t°	Mol. % CH_3COOH	Solid Phase
13.9	96	CH_3COOH	-87.5	44.8	$(CH_3)_3PO_4$ α
5.8	86.7	"	-72.9	37.1	"
0.7	80.8	"	-55.4	19.1	"
-8.3	75.0	"	-46.1	0.0	"
-22.9	66.4	"	-75.6	24.9	$(CH_3)_3PO_4$ β
-41.3	58.8	"	-70.4	15.9	"
-70.2	51.4	"	-67.3	11.3	"
-89.9*	47.1	CH_3COOH + $(CH_3)_3PO_4$ α	-62.4	0.0	"

* = (Eutec.)

GLYCOLIC ACID $CH_2OHCOOH$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Glycolic Acid between Ethyl Ether and Water, for concentrations of 4.9 to 24 millimols per liter in the ether layer is 0.028 at 25° (Collander, 1949, quoted from Dermer, Murkham and Trimble, 1941).

Correction Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 117, GLYCOLIC ACID, Solubility in Water. These results are for Glycocholic Acid, $C_{24}H_{39}O_4 \cdot NHCH_2COOH$, instead of for Glycolic Acid, and the reference is Emich (1882) Monatsh. Chem. 3 336-40.

ETHYL CHLORIDE C_2H_5Cl

SOLUBILITY OF ETHYL CHLORIDE VAPOR IN WATER, IN BLOOD AND IN SERUM
(Nicloux and Scotti-Foglieni, 1929)

The apparatus and procedure described in the Note under Chloroform (p.572) was used. The mixtures of Air and Ethyl Chloride were prepared by allowing the air which entered the gasometer to bubble through ethyl chloride. The mixture contained 10-15 gms. C_2H_5Cl per 150 liters of air, corresponding to a vapor tension of C_2H_5Cl of 20-30 mm-Hg. The samples of the air-vapor mixtures and the saturated liquids were analyzed by a method which gave the volume of C_2H_5Cl per 100 cc of each phase. The quotient of the volume in the liquid phase divided by the volume in the air-vapor mixture, corrected for temperature and pressure, was taken as the coefficient of solubility.

	Coefficient of Solubility of Ethyl Chloride in:				
		Blood of		Serum of	
t°	H_2O	Beef	Pork	Beef	Pork
20	2.12	2.87	4.36	2.26	2.32
25	1.62	--	3.89	1.90	2.02
30	1.37	2.00	3.20	1.58	1.64
35	--	1.50	2.66	1.23	1.36
40	0.89	1.31	2.13	1.03	1.12

ETHYL IODIDE C_2H_5I

The distribution coefficient of Ethyl Iodide between Ethyl Ether and water for concentrations of 933 millimols per liter in the ether layer divided by 3.33 millimols per liter in the water layer is 280 at 18°. (Collander, 1949)

ACETAMIDE CH_3CONH_2

The coefficient of distribution $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Acetamide between Ethyl Ether and Water, for a concentration of 2000 millimols per liter of water layer is 0.0025 at 22° (Collander, 1949, quoted from Bärlund, 1929).

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 121 last table, remove Critical Solution from heading, leaving simply Temperatures of Separation etc.

FREEZING-POINTS OF MIXTURES OF ACETAMIDE AND AMMONIA
(Sisler, Davidson, Stoenner, and Lyon, 1944)

The sealed tube method of determination was used and the temperature of freezing was taken as the point at which the last crystal disappeared on slow warming.

t°	Mol. % CH_3CONH_2	Solid Phase	t°	Mol. % CH_3CONH_2	Solid Phase
80.2	100	CH_3CONH_2	-53	15.6	1:1
65.4	78.3	"	-69.0	10.3	"
48.8	62.2	"	-82 (Eutec)	8.0	1:1 + NH_3
30.0	49.4	"	-80	4.3	NH_3
9.5	39.2	"	-77.5	0.0	"
-9.0	31.2	"	80.2	100.0	CH_3CONH_2*
-31.0**	32.7	CH_3CONH_2 + 1:1	59.2	86.6	"
-35.5	28.6	1:1	49.6	75.4	"
-43.0	22.2	"	40.0	67.1	"

1:1 = $CH_3CONH_2 \cdot NH_3$ *Metastable form of acetamide **(tr. pt.)

FREEZING-POINTS OF MIXTURES OF ACETAMIDE AND ACETIC ACID
(Sisler, Davidson, Stoenner, and Lyon, 1944)

t°	Mol. % CH_3CONH_2	Solid Phase	t°	Mol. % CH_3CONH_2	Solid Phase
80.2	100	CH_3CONH_2	-3.9	36.5	1:1
72.5	88.5	"	-9.2	31.8	"
63.0	79.1	"	-11.7**	30.0	1:1 + $HC_2H_3O_2$
51.9	70.0	"	- 9.4	28.2	$HC_2H_3O_2$
35.6	59.8	"	0.0	21.1	"
8.0	48.5	"	3.0	12.2	"
- 0.2*	42.1	CH_3CONH_2 + 1:1	12.9	5.8	"
- 0.6	44.2	1:1	16.6	0.0	"

1:1 = $CH_3CONH_2 \cdot HC_2H_3O_2$ *(tr. pt.) **(Eutec.)

FREEZING-POINTS OF MIXTURES OF ACETAMIDE AND CYANO ACETIC ACID
(Alibanskii, 1949)

The results are given in the form of a diagram from which the following approximate values were read.

t°	Gm. Mols. $CH_2CNCOOH$ per 100 gm. mols Mixture	Solid Phase	t°	Gm. Mols. $CH_2CNCOOH$ per 100 gm. mols. Mixture	Solid Phase
81	0.0	CH_3CCNH_2	55	61.0	1:1
60	20.0	"	44	70.0	"
49.6	28.2	CH_3CONH_2 + 1:1	35.0	75.65	1:1 + $CH_2CNCOOH$
52.5	32.5	1:1	50	83.	$CH_2CNCOOH$
60	43.0	"	60	91	"
62.6	50.0	"	68.8	100	"

1:1 = $CH_3CONH_2 \cdot CH_2CNCOOH$

Freezing-point data are given for:

Acetamide + Diphenyl Amine (Vogels and Walop, 1943)
" + Chloro Benzene (Linde, 1942)
" + Picric Acid (Pushin and Kozuhar, 1947)
" + Acenaphthene (Kofler, 1948)
" + Benzil " "
" + Naphthol Methyl Ether " "
" + Nitrophenol " "
" + Trinitro Toluene " "

GLYCINE CH_2NH_2COOH

100 gms. H_2O dissolve 25.03 gms. CH_2NH_2COOH at 25° (Mason, 1947)

One liter sat. solution in H_2O contains 2.9 gm. mols. CH_2NH_2COOH at 25° (Zachary and Moore, 1949)

SOLUBILITY OF GLYCINE IN LIQUID AMMONIA
(Zachary and Moore, 1949)

t°		Gm. mols. CH_2NH_2COOH per liter sat. sol.
°K	°C	
196	-77	0.20
210	-63	0.65
227.5	-45.5	2.52
238	-35	3.95

GLYCINE PHOSPHOTUNGSTATE $(CH_2NH_2COOH)_3 \cdot HPO_4 \cdot 12WO_3 \cdot 5H_2O$

SOLUBILITY OF GLYCINE PHOSPHOTUNGSTATE IN AQUEOUS SOLUTIONS AT 22°

(Van Slyke, Hiller, and Dillon, 1942)

The determinations were made both by precipitation and by resolution of the phosphotungstate in the aqueous solvents. Varying ratios of excess phosphotungstic acid (PTA) and of Glycine, and also of concentration of hydrochloric acid, were used.

Original Solvent		Additional millimols per liter		Solubility of $(CH_2NH_2COOH)_3 \cdot PTA \cdot 5H_2O$ in millimols per liter	
Normality HCl	Gms. PTA per liter	CH_2NH_2COOH	PTA	Precipitation Method	Resolution Method
1.0	50.0	89	46.3	39.0	37.0
"	"	133	60.9	37.0	37.2
"	"	266	105.3	36.6	37.0
0.25	"	--	--	--	32.8
0.5	"	--	--	--	35.4
1.0	"	--	--	--	37.0
2.0	"	--	--	--	31.8
3.0	"	--	--	--	27.1

Results for the effect of temperature on the solubility of Glycine Phosphotungstate in aqueous 0.25 normal HCl, determined by the resolution method, are given in the form of a diagram from which the following approximate values were read.

t°	Solubility of Glycine PTA expressed as Mgs. amino acid N per liter
0	180
10	280
20	430
25	510
30	650
40	950

METHYL CARBAMATE (Methyl Urethan) NH_2COOCH_3

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Methyl Carbamate between Ethyl Ether and Water, for concentrations of 400 millimols per liter in the ether layer, is 0.14 at 23° (Collander, 1949, quoted from Bärlund, 1929)

ETHANE C_2H_6

SOLUBILITY OF ETHANE IN WATER

Using an apparatus in which a liquid film was made to flow through the gas, the coefficient of solubility of ethane in water was found to be 0.0391 at 25° (Morrison and Billett, 1948)

PHASE EQUILIBRIUM IN THE SYSTEM ETHANE - n BUTANE

Diagrams and numerical date for the P-V-T-X relations of the liquid-vapor phase boundaries in the system Ethane-n Butane are given by Kay, 1940.

ETHYL ALCOHOL C_2H_5OH

SOLUBILITY OF ETHYL ALCOHOL IN SEVERAL SOLVENTS AT 4.5°C
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Solvent	Mol. Fraction C_2H_5OH in sat. sol.	Solvent	Mol. Fraction C_2H_5OH in sat. sol.
Triethylene tetramine	0.508	Hexamethylene	0.445
Methylated triethylene tetramine I	0.469	N, N Dimethyl acetamide	0.314
Methylated triethylene tetramine II	0.416	Ethylene glycol	0.110
		Triethyl phosphate	0.363

SOLUBILITY OF ETHYL ALCOHOL IN NITROGLYCERIN AND VICE VERSA
(Coperman, 1936)

A titration method was used. The ethyl alcohol was of specific gravity 0.812 at 15/15° which corresponds to 93.9 wt. % C_2H_5OH

t°	Gms. C_2H_5OH per 100 gms. sat. sol. in Nitroglycerin	t°	Gms. Nitroglycerin per 100 gms. sat. sol. in C_2H_5OH
15	3.2	15	25.0
20	3.9	20	27.3
25	4.85	25	30.0
30	5.9	28	31.8
35	7.4	30	32.9
40	9.7	32	34.3
		35	36.7
		40	41.4

EQUILIBRIUM IN THE SYSTEM ETHYL ALCOHOL, ETHYL ACETATE AND WATER
(Griswold, Chu, and Winsauer, 1949)

Both the liquid-liquid and liquid-vapor phase equilibria were determined. For the former the temperature of clouding in weighed mixtures of the three components, contained in sealed ampules, were observed. The tie-line data was obtained by analyzing liquid phase samples brought to equilibrium at constant temperature. The final results are shown in triangular diagrams from which numerical values cannot be accurately deduced.

The distribution coefficient of Ethyl Alcohol between Ethyl Ether and Water, for a concentration of 275 millimols per liter in the ether layer divided by 1050 millimols per liter in the water layer, is 0.26 at 19° (Collander, 1949)

EQUILIBRIUM IN THE SYSTEM ETHYL ALCOHOL, ETHYL VINYL ETHER AND WATER AT 25°
(Siggia and Hanna, 1949)

Note - The determinations were made by a method in which it was necessary to determine chemically only one of the three components. Mixtures of the two immiscible components were titrated with the third component until turbidity appeared. The percentage of each component was calculated and the corresponding points plotted on a triangular diagram.

Gms. per 100 gms. Mixture		
C_2H_5OH	$CH:CH_2OC_2H_5$	H_2O
75.7	9.72	14.3
64.1	24.7	10.9
61.6	9.96	28.3
54.6	22.9	22.5
49.66	45.0	5.41

PHASE EQUILIBRIUM IN THE SYSTEM ETHYL ALCOHOL - WATER

Results for equilibrium conditions of temperature, pressure and composition of the liquid and vapor phases of the system Ethyl Alcohol - Water are given by

Langdon and Keyes, 1942
Beebe, Coulter, Lindsay, and Baker, 1942
Othmer and Gilmont, 1948

PHASE EQUILIBRIUM IN THE SYSTEM ETHYL ALCOHOL - ACETONE

Vapor pressure measurements and liquid-vapor equilibrium results with compositions in mol. fractions for the system Ethyl Alcohol-Acetone at 32°, 40° and 48° are given by Gordon and Hines, 1946.

PHASE EQUILIBRIUM IN THE SYSTEM ETHYL ALCOHOL - ETHYL ETHER

Vapor pressure measurements and liquid-vapor equilibrium results with compositions in mol. fractions for the system Ethyl Alcohol-Ethyl Ether at 25° are given by Gordon and Hornibrook, 1946.

PHASE EQUILIBRIUM IN THE SYSTEM ETHYL ALCOHOL - n BUTYL ALCOHOL

Diagrams and numerical data for the temperature composition, vapor-liquid equilibria and refractive index compositions for the system Ethyl Alcohol- n Butyl Alcohol at one atmosphere pressure and temperatures up to 120° are given by Brunies and Bogert, 1943.

Results for the densities and refractive indices of binary and ternary mixtures of Ethyl Alcohol,Carbon Tetrachloride and Benzene at 25° are given by Campbell and Miller, 1947.

METHYL UREA $NH_2CONHCH_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Methyl Urea between Ethyl Ether and Water, for a concentration of 750 millimols in the water layer, is 0.0012 at 23°. (Collander, 1949, quoted from Bärlund, 1929.

ETHYLENE GLYCOL CH_2OHCH_2OH

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Ethylene Glycol between Ethyl Ether and Water, for a concentration of 1000 millimols in the water layer is 0.0053 at room temperature (Collander, 1949).

Correction to Vol. 2, 3rd. Ed. of Solubilities of Organic Compounds p. 157 last table, the headings of the 2nd and 3rd columns of figures should be interchanged. This should also be done for the 5th and 6th columns of figures

METHYLOL UREA $C_2H_6O_2N_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Methylol Urea between Ethyl Ether and Water, for a concentration of 700 millimols in the water layer, is 0.00028 at room temperature (Collander, 1949, quoted from Collander and Bärlund, 1933).

DIMETHYL AMINE $(CH_3)_2NH$

The distribution coefficient of Dimethyl Amine between Ethyl Ether and Water, for a concentration pf 5.0 millimols per liter of the ether layer divided by 90.9 millimols per liter of the water layer is 0.055 at 15°. (Collander, 1949).

ETHYL AMINE $C_2H_5NH_2$

The distribution coefficient of Ethyl Amine between Ethyl Ether and Water, for a concentration of 5.2 millimols per liter of the Ether layer divided by 86.0 millimols of the water layer, is 0.060 at 18° (Collander, 1949).

ETHANOL AMINE $NH_2CH_2CH_2OH$

The distribution coefficient of Ethanol Amine between Ethyl Ether and Water, for a concentration pf 1.2 millimols per liter of ether layer divided by 945 millimols per liter of the water layer is 0.0013 at 19°, (Collander, 1943).

EQUILIBRIUM IN THE SYSTEM MONOETHANOL AMINE, ETHYL ETHER AND PYRIDINE AT 25°

(Siggia and Hanna, 1949)

See Note. p. 600

Gms. per 100 gms. Mixture		
$NH_2CH_2CH_2OH$	$(C_2H_5)_2O$	C_5N_5N
24.9	12.8	63.6
26.0	11.8	62.2
53.4	4.4	42.2
61.0	9.9	29.1
16.2	21.8	62.1
40.7	9.1	50.1

ETHYLENE DIAMINE $C_2H_4(NH_2)_2$

The distribution coefficient of Ethylene Diamine between Ethyl Ether and Water, for a concentration of 0.335 millimols per liter in the ether layer divided by 1020 millimols per liter of the water layer is 0.00033 at 22° (Collander, 1949).

Freezing-point data are given for Ethylene Diamine and:

Benzoic Acid (1)
Salicylic Acid (1)
Maleic Acid (1)
Maleic Anhydride (1)
o Phthalic Acid (1)

(1) Dionisev, 1949.

Diphenyl Amine (2)
Pinacone (2)
Diphenyl Carbinol (2)
Triphenyl Carbinol (2)
Salicyl Aldehyde (2)

(2) Fushin and Dimitrijevic, 1947.

ACRYLONITRILE $CH_2:CHCN$

SOLUBILITY OF ACRYLONITRILE IN WATER AND VICE VERSA
(Davis and Wiedeman, 1945)

The determinations were made by the sealed bulb method, noting the temperatures at which clouding appeared or disappeared. The following results were taken from the authors' diagrams.

$CH_2:CHCN$ in H_2O		H_2O in $CH_2:CHCN$			
t°	Gms. CH_2 = CHCN per 100 gms. sat. sol.	t°	Gms. H_2O per 100 gms. sat. sol.	t°	Gms. H_2O per 100 gms. sat. sol.
0	7.2	-83.5	0.0	30	3.75
20	7.3	-50	0.4	40	4.8
25	7.4	-30	0.9	50	6.2
40	7.9	-10	1.7	60	7.5
50	8.4	0	2.1	70	9.0
60	9.05	+10	2.5	80	10.7
80	10.9	20	3.1	90	12.6
90	12.7	25	3.4	95	14.0

PROPARGYL ALCOHOL (2 - Propyn - 1 ol) $CH:CCH_2OH$

Diagrams and numerical results for the vapor-liquid phase equilibria in the system Propargyl Alcohol, Benzene and Water are given by Simonetta and Mugnaini , (1948).

ACRYLIC ACID $CH_2:CHCOOH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Acrylic Acid between Ethyl Ether and Water, for concentrations of 57 to 604 millimols per liter of the ether layer is 2.0-2.3 at 25° (Collander, 1949, quoted from Derner, Markham, and Trimble, 1941).

MALONIC ACID $CH_2(COOH)_2$

DISTRIBUTION OF MALONIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26°C.and calculating the concentration of the latter by difference. The distribution coefficient K is the conc. in the water layer (approx. 0.16%) divided by the conc. in the organic solvent layer.

Results for K in:

$\frac{H_2O}{}$ n Butanol	$\frac{H_2O}{}$ Ethyl Acetate	$\frac{H_2O}{}$ Ethyl Ether	$\frac{H_2O}{}$ Chloroform	$\frac{H_2O}{}$ Skellysolve B
1.5 - 1.9	4.0 - 4.5	8.1 - 8.5	10+	10+

BROMO PROPIONIC ACID $CH_3CHBrCOOH$

The distribution coefficient of α Bromo Propionic Acid between Ethyl Ether and Water, for concentrations of 847 millimols per liter of the ether layer divided by 65 millimols per liter in the water layer is 13 at 19° (Collander, 1949).

ALLYL ISOTHIO CYANATE $CH_2:CHCH_2NCS$

Freezing-point data for mixtures of Allyl Isothio Cyanate with Ortho Toluidine, Para Toluidine and with Benzylamine are given by Pushin, 1948.

PROPYLENE (Propene) $CH_2:CHCH_3$

SOLUBILITY OF PROPYLENE IN WATER AND IN AQUEOUS SOLUTIONS OF DETERGENTS AT 25° AND 500-700 mm PRESSURE

(McBain and Soldate, 1942)

Detergent	Gm. Detergent per 100 cc Aqueous Solvent	Gm. x 10^{-5} C_3H_6 per gm. H_2O per mm Pressure
Water	0.0	3.4
K. Oleate	1.0	3.7
"	9.0	12.5
"	12.0	14.9
"	15.0	18.7
Tergitol 4	15.0	13.6
Aerosol OT	1.0	3.4
"	1.5	7.5
" MA	15.0	11.0
1 pt. OT + 4 pts. MA	15.0	10.1
Aerosol AV	1.0	3.0 (?)
"	15.0	8.9
" IB	10.0	4.6
"	15.0	5.7
"	15.0	7.5
Na Desoxycholate	15.0	6.1
Na Dehydrocholate	15.0	0.8
Aquasol AR	15.0	14.4
Igepon A	15.0	7.7
95% Triton NE	15.0	11.3
90% Alronal	15.0	12.4
Triton K 60	25.0	32.6
K Novenate	15.0	11.2
Nacconol NR	10.0	9.2
Sapamine KW	10.0	5.4
Diethyl Carbitol	15.0	3.7
Calgon	0.4	3.8
"	2.0	3.3
"	5.0	3.8
KOH + 0.2% Calgon	12.0	14.6
KOH + 3.0% Calgon	12.0	15.2
K_2CO_3	5.0	3.0
"	0.5	3.5
K_2CO_3 5% + KOH	12.0	15.9
K_2CO_3 0.2% + KOH	12.0	14.1
2% tetra Na pyro phosphate + KOH	12.0	14.5
5% tetra Na pyro phosphate + KOH	12.0	15.6

Numerical results and curves for the vapor-liquid equilibrium in the system Propylene - Iso butane, at temperatures from 100 to 290°F. and pressures from 200 to 600 pounds per sq. inch, are given by Gilliland and Scheeline, 1940.

Correction to Vol. 2, 3rd. Ed. of Solubilities of Organic Compounds, p. 174, 2nd. table, the seventh line of figures should read -10, 3.2, 6.5, 13.0, 19.1, 26.0, 33.2, 40.5, 48.5, 53.4. In the last two lines the designations Heavy Benzin and Light Benzin should be interchanged.

MELAMINE $N:C(NH_2)N:C(NH_2)N:CNH_2$

SOLUBILITY OF MELAMINE IN WATER

(Chapman, Averell, and Harris, 1943)

t°	Gm. $C_3H_6N_6$ per 100 gms. H_2O	t°	Gm. $C_3H_6N_6$ per 100 gms. H_2O
19.9	0.324	74.5	2.37
34.9	0.590	83.5	3.15
49.8	1.045	94.8	4.59
64.1	1.70	99.0	5.05

MELAMINE PHOSPHATES $C_3H_6N_6 \cdot H_3PO_4$ etc.

SOLUBILITY OF MELAMINE PHOSPHATES, EACH SEPARATELY, IN WATER

(Volfkovitch, Zusser, and Remen, 1946)

t°	Gms. Phosphate per 100 gms. sat. sol.		
	Ortho Phosphate	Meta Phosphate	Pyro Phosphate
	$C_3H_6N_6 \cdot H_3PO_4$	$C_3H_6N_6 \cdot HPO_3$	$(C_2H_6N_6)_2 \cdot H_4P_2O_7$
20	0.35	0.09	0.09
40	0.63	0.13	0.17
60	1.16	0.24	1.24
80	1.83	0.53	0.32
100	2.94	1.60	0.54

ACETONE $(CH_3)_2CO$

PHASE EQUILIBRIUM IN THE SYSTEM ACETONE - WATER

Diagrams and numerical data for vapor-liquid equilibria in the system Acetone- Water are given by Brunjes and Bogert, 1943, and by Othmer, Kollman and White, 1944. The latter authors also give data for Acetone- Hydrocarbon Oil Systems.

RECIPROCAL SOLUBILITY OF ACETONE, n HEXANE AND WATER AT 25°

(Treybal and Vondrak, 1949)

Note: Mixtures of Acetone and Hexane were titrated with water to appearance of slight turbidity, indicating limiting solubility concentrations. For tie lines and compositions of liquid layers in contact, mixtures of known compositions were allowed to separate at 25° and the two layers analyzed by means of density and refractive index determinations, in comparison with large scale plots of these data made upon mixtures of known composition.

Limiting Solubility Concentrations

d_4^{25}	Gms. per 100 gms. Mixture		d_4^{25}	Gms. per 100 gms. Mixture	
	$(CH_3)_2CO$	H_2O		$(CH_3)_2CO$	H_2O
0.9781	13.57	86.31	0.8292	73.37	19.71
0.9564	28.18	71.67	--	74.01	15.90
--	37.73	62.06	0.7914	71.04	11.74
0.9260	44.48	55.21	0.7531	61.27	5.31
0.9241	45.26	54.37	0.7291	50.80	2.56
0.8893	59.08	39.33	0.7144	40.96	0.97
0.8773	63.18	34.92	0.7043	33.72	0.39
0.8446	71.84	23.27	0.6901	19.25	0.14

Tie Line Equilibrium Concentrations

Lower Layer		Upper Layer	
Gms. per 100 gms. Mixture		Gms. per 100 gms. Mixture	
$(CH_3)_2CO$	H_2O	$(CH_3)_2CO$	H_2O
27.01	72.8	9.28	0.0
43.55	56.1	21.10	0.3
52.61	46.5	29.28	0.4
56.10	42.7	33.85	0.5
57.64	41.0	36.21	0.8
63.00	35.0	44.20	1.2
68.52	28.5	52.18	1.8
Estimated Plait Point		71.1	11.8

RECIPROCAL SOLUBILITY OF ACETONE, n HEPTANE AND WATER AT 25°

See note above

Limiting Solubility Concentrations

d_4^{25}	Gms. per 100 gms. Mixture		d_4^{25}	Gms. per 100 gms. Mixture	
	$(CH_3)_2CO$	H_2O		$(CH_3)_2CO$	H_2O
0.9731	17.07	82.82	0.8098	76.17	14.21
0.9615	25.29	74.60	0.7681	70.27	6.28
0.9250	43.13	56.68	0.7633	68.86	5.45
0.9151	49.86	49.85	0.7266	49.29	2.02
0.8931	58.89	40.43	0.7131	39.53	1.10
0.8867	60.79	38.43	0.7016	30.72	0.57
0.8753	64.98	33.73	0.6922	19.91	0.28
0.8606	69.26	28.58	0.6847	10.00	0.00
0.8513	72.29	24.76			

Tie Line Equilibrium Concentrations

Lower layer		Upper layer	
Gms. per 100 gms. Mixture		Gms. per 100 gms. Mixture	
$(CH_3)_2CO$	H_2O	$(CH_3)_2CO$	H_2O
24.79	75.2	6.80	0.0
40.00	59.7	12.41	0.0
62.97	36.0	27.22	0.6
73.11	23.6	38.02	1.0
75.03	20.2	41.00	1.0
Estimated Plait Point		67.5	5.0

Correction to Vol. 2, 3rd. Edition of Solubilities of Organic Compounds p. 177, last table. The first and second column headings should be interchanged. The fourth column heading should be moved to the sixth column and the present fifth and sixth column headings moved to the fourth and fifth columns.

The distribution coefficient of Acetone between Ethyl Ether and Water, for concentrations of 383 millimols per liter of the ether layer divided by 617 millimols per liter of water layer, is 0.62 at 20° (Collander, 1949).

FREEZING-POINTS OF MIXTURES OF ACETONE AND DIACETONE ALCOHOL
(Lautz, 1940)

t°	Gms. $(CH_3)_2CO$ per 100 gms. Mixture	t°	Gms. $(CH_3)_2CO$ per 100 gms. Mixture
-44	0.0	-52.5	13.0
-46.9	4.3	-55.5	20.0
-50.4	8.6		

Results for the viscosity of the mixtures are also given.

PROPION ALDEHYDE CH_3CH_2CHO

SOLUBILITY OF PROPION ALDEHYDE - DIMEDON CONDENSATION COMPOUND AT 25°
(Yoe and Reid, 1941)

Dimedon is the name given to 1.3 Cyclohexanedione 5,5 dimethyl.

100 cc of aq. buffer solution of pH 4.6 dissolve 0.0034 gm. Propion Aldehyde - Dimedon Compound.

100 cc of aq. buffer solution of pH 4.6 containing 0.08 gm. of dimedon dissolve 0.0006 gm. of Propion Aldehyde - Dimedon Compound.

The distribution coefficient of Propion Aldehyde between Ethyl Ether and Water, for concentrations of 710 millimols per liter of the Ether layer divided by 617 millimols per liter of the water layer, is 2.0 at 19° (Collander, 1949).

PROPIONIC ACID CH_3CH_2COOH

DISTRIBUTION OF PROPIONIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration in the latter by the difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.16%) divided by the conc. in the organic solvent layer.

Distribution coefficient K in:

H_2O	H_2O	H_2O	H_2O	H_2O
n Butanol	Ethyl Acetate	Ethyl Ether	Chloroform	Skellysolve B
0.36	0.45	0.67	5.6 - 7.6	10 +

The distribution coefficient of Propionic Acid between Ethyl Ether and Water, for concentrations of 25.6 - 117 millimols per liter in the ether layer divided by 15.0 - 67 millimols per liter in the water layer is 1.7 - 1.8 at 22° (Collander, 1949, quoted from Behrens, 1926).

METHYL ACETATE CH_3COOCH_3

The distribution coefficient of Methyl Acetate between Ethyl Ether and Water, for concentrations of 473 millimols per liter of ether layer divided by 177 millimols per liter of water layer is 2.7 at 20° (Collander, 1949).

MALONAMIDE $CH_2(CONH_2)_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Malonamide between Ethyl Ether and Water, for a concentration of 900 millimols per liter of the water layer, is 0.0003 at room temperature (Collander, 1949, quoted from Collander and Bärlund, 1933).

β OXY PROPIONIC ACID (Hydracrylic Acid) CH_2OHCH_2COOH

The distribution coefficient of β Oxy Propionic Acid between Ethyl Ether and Water, for concentrations of 6.84 millimols per liter of the ether layer divided by 81.8 millimols per liter of the water layer is 0.084 at room temperature (Collander, 1949).

GLYCERIC ACID $CH_2OHCHOHCOOH$

The distribution coefficient of Glyceric Acid between Ethyl Ether and Water, for concentrations of 0.84 millimols per liter in the ether layer divided by 92.1 millimols per liter in the water layer is 0.009 at 19° (Collander, 1949).

PROPANE -1 SULFAMIDE

Freezing-point data for mixtures of Propane - Sulfamide and Propane - 2 Sulfamide are given by Asinger, Schmidt, and Ebender, 1942.

PROPIONAMIDE $CH_3CH_2CONH_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Propionamide between Ethyl Ether and Water, for concentrations of 500 millimols per liter in the water layer is 0.013 at 23° (Collander, 1949, quoted from Bärlund, 1929).

Correction to Vol. 2, 3rd. Ed. of Solubilities of Organic Compounds, p. 198, under Propionamide the table heading should read Demixing Temperatures instead of Critical Solution Temperatures.

URETHAN (Ethyl Carbamate) $NH_2COOC_2H_5$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Urethan between Ethyl Ether and Water, for a concentration of 500 millimols per liter in the water layer is 0.64 at 22° (Collander 1949, quoted from Bärlund, 1929).

Freezing-point data are given for:

Urethan + Picric Acid (Pushin and Kozuhar, 1947)

Urethan + Nitrobenzene + Allyl phenyl thio urea (Chichokin and Muskina, 1938)

Urethan + Nitrobenzene + Acetanilide Chichokin and Muskina, 1938)

ALANINE CH_3CHNH_2COOH

The distribution coefficient of α Alanine between Ethyl Ether and Water, for concentrations of 0.0014 millimols per liter of the ether layer divided by 1000 millimols per liter of the water layer is 0.0000014 at 19° (Collander, 1949).

GLYCOCOL METHYL ESTER (Glycine) $NH_2CH_2COOCH_3$

The distribution coefficient of Glycocol Methyl Ester between Ethyl Ether and Water, for concentrations of 22 millimols per liter of the ether layer divided by 299 millimols per liter of the water layer is 0.073 at 23° (Collander, 1949).

LACTAMIDE $CH_3CHOHCONH_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Lactamide between Ethyl Ether and Water, for a concentration of 1000 millimols per liter of the water layer is 0.0018 at room temperature (Collander, 1949, quoted from Bärlund, 1929).

GLYCEROL α CHLOROHYDRIN $CH_2ClCHOHCH_2OH$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Glycerol α Chlorohydrin between Ethyl Ether and Water, for a concentration of 750 millimols per liter in the water layer is 0.08 at 23° (Collander, 1949, quoted from Bärlund, 1929).

SERINE $CH_2OHCH(NH_2)COOH$

100 cc Acetic Acid dissolve 0.088 gm. Serine at 18° (Przylecki and Kasprzyle-Czaykowska, 1938).

PROPANE $CH_3CH_2CH_3$

SOLUBILITY OF PROPANE IN BENZENE AT HIGH TEMPERATURES AND PRESSURES
(Ipatieff and Monroe, 1942)

t°	Atms. Pressure (guage)	Gms. C_3H_8 per 100 gms. C_6H_6	t°	Atms. Pressure (guage)	Gms. C_3H_8 per 100 gms. C_6H_6
110	10	22.12	175	30	22.60
150	10	7.41	217	30	8.13
150	22	22.26	195	40	23.08
190	22	7.88	242	40	8.32

The Pressure, Volume and Temperature relations of Propane for the range 30 to 336°C and 1 to 130 atmospheres pressure are given by Deschner and Brown, 1940. The entropy and enthalpy of propane have been calculated by Burgoyne, 1940.

Results for the volumetric and phase behavior in the system Propane - n Butane at temperatures above 160°F are given by Nysewander, Sage, and Lacey, 1940.

Results for equilibrium conditions of temperature, pressure and composition of the liquid and vapor phases of the system Propane - Pentane are given by Sage and Lacey, 1940, and by Othmer and Gilmont, 1948.

Diagrams and numerical data for the P-V-T-X relation in the system Propane - iso Pentane at temperatures between 0 and 300 and pressures from 2 to 80 atmospheres are given by Vaughan and Collins, 1942.

PROPYL ALCOHOL $CH_3CH_2CH_2OH$

SOLUBILITY OF n PROPYL ALCOHOL IN TWO SOLVENTS AT 4.5°C
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Solvent	Mol. Fraction C_3H_7OH in sat. sol.	Solvent	Mol. Fraction C_3H_7OH in sat. sol.
Triethylene tetramine	0.362	Hexamethylene diamine	0.370

The distribution coefficient of n. Propyl Alcohol between Ethyl Ether and Water, for concentrations of 1770 millimols per liter in the ether layer divided by 935 millimols per liter in the water layer is 1.9 at 22° (Collander, 1949).

ISOPROPYL ALCOHOL $CH_3CHOHCH_3$

MUTUAL SOLUBILITY OF ISOPROPYL ALCOHOL, DIISOPROPYL ETHER AND WATER AT 25°

(Prere, 1949)

Mixtures of two of the components were titrated with the third to appearance of turbidity, indicating limited solubility concentrations. For the tie lines, mixtures of the three components, corresponding to points within the binodal curve, were agitated at constant temperature and the two layers allowed to separate. The densities of these were determined and compared with a large scale plot of densities of known mixtures of the three components.

Limiting Solubility Concentrations

d_4^{25}	Gms. per 100 gms. Mixture		d_4^{25}	Gms. per 100 gms. Mixture	
	C_3H_8O	H_2O		C_3H_8O	H_2O
0.7210	---	0.5	0.8275	45.7	26.0
0.7274	5.5	1.1	0.8450	45.0	32.1
0.7326	9.5	1.5	0.8590	43.5	37.0
0.7427	16.9	3.2	0.8884	39.0	48.4
0.7500	22.5	4.7	0.9084	35.8	55.6
0.7605	28.0	6.7	0.9245	32.3	61.8
0.7698	32.8	8.9	0.9437	27.0	69.6
0.7812	37.6	11.6	0.9634	20.0	78.3
0.7958	41.9	15.5	0.9706	9.4	89.4
0.8180	45.5	23.0	0.9864	5.2	93.8

Conjugate layers in the Ternary System

Upper Layer			Lower Layer		
Gms. per 100 gms. sat. sol.			Gms. per 100 gms. sat. sol.		
$C_6H_{14}O$	H_2O	C_3H_8O	$C_6H_{14}O$	H_2O	C_3H_8O
96.4	0.8	2.8	1.0	92.1	6.9
93.0	1.2	5.8	1.2	89.0	9.8
90.1	1.5	8.4	1.2	86.9	11.9
86.1	2.0	11.9	1.2	85.4	13.4
82.8	2.7	14.5	1.2	83.8	15.0
76.3	4.0	19.7	1.3	82.4	16.3
72.1	5.0	22.9	1.4	81.6	17.0
64.2	7.0	28.8	1.4	80.3	18.3
54.2	10.2	35.6	1.7	77.8	20.5
45.4	14.0	40.6	2.3	74.1	22.6
36.9	18.7	44.4	2.9	71.2	25.9
31.5	23.0	45.5	3.7	68.3	28.0
25.3	29.0	45.7	4.7	64.6	20.7
	Estimated Plait Point		9.8	53.3	36.9

The solubility of Iso Propyl Alcohol at 4.5°C in:

Triethylene tetramine is 0.357 mol. fraction of the sat. solution.

Hexamethylene diamine is 0.362 mol. fraction of the sat. solution.

(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Liquid-vapor phase equilibrium result for the system Iso Propyl Alcohol-Water are given by Langdon and Keyes, 1042 and Brunjes and Bogert, 1943.

Liquid-vapor phase equilibrium results for the system Iso Propyl Alcohol-Iso Propyl Ether are given by Miller and Bliss, 1940.

DIMETHYL UREA sym. $CH_3NHCONHCH_3$ asym. $(CH_3)_2NCONH_2$

DISTRIBUTION BETWEEN ETHYL ETHER AND WATER AT 19°
(Collander, 1949)

Compound	Millimols Compound per liter		Dist. Coef. K conc. Ether ÷ conc. H_2O
	Ether Layer	Water Layer	
sym $CH_3NHCONHCH_3$	7.01	2260	0.0031
asym. $(CH_3)_2NCONH_2$	6.29	2168	0.0029

ETHYL UREA $NH_2CONHC_2H_5$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Ethyl Urea between Ethyl Ether and Water, for a concentration in the water layer of 500 millimols per liter is 0.0041 at room temperature (Collander, 1949, quoted from Collander and Bärlund, 1923)

GLYCOL MONOMETHYL ETHER $CH_3OCH_2CH_2OH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glycol Monomethyl Ether between Ethyl Ether and Water, for a concentration of 1900 millimols in the water layer is 0.15 at 18° (Collander, 1949).

Liquid-vapor phase equilibrium results for the system Glycol Monomethyl Ether - Diethylene Glycol Monomethyl Ether are given by Simonetta and Barakan, 1947.

1, 2 PROPYLENE GLYCOL (1, 2 Propanediol) $CH_2OH\ CHOHCH_3$

The distribution coefficient of Propylene Glycol between Ethyl Ether and Water, for concentrations of 23.0 millimols per liter in the ether layer divided by 1280 millimols per liter in the water layer is 0.018 at 20° (Collander, 1949).

TRIMETHYLENE GLYCOL $C_3H_8O_2$

The distribution coefficient of Trimethylene Glycol between Ethyl Ether and Water, for concentrations of 15.3 millimols per liter of ether layer divided by 1520 millimols per liter of the water layer is 0.01 at 20° (Collander, 1949).

GLYCEROL $CH_2OHCHOHCH_2OH$

A saturated solution of H_2O in Glycerol contains 0.239 mol. fraction H_2O at 4.5° (Copley, Ginsberg, Zellhoeffer, and Marvel, 1941).

100 gms. saturated solution of Glycerol in Furfural contains 2.1 to 2.8 gms. glycerol at 25° (Trimble, 1941).

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Glycerol between Ethyl Ether and Water, for a concentration of 1000 millimols in the water layer is 0.00066 at room temperature. (Collander, 1949, quoted from Collander and Bärlund, 1933).

TRIMETHYL PHOSPHATE $(CH_3)_3PO_4$

FREEZING-POINTS OF MIXTURES OF TRIMETHYL PHOSPHATE AND WATER
(Pagel and Maxey, 1941)

t°	Mol. % $(CH_3)_3PO_4$	Solid Phase	t°	Mol. % $(CH_3)_3PO_4$	Solid Phase
-2.1	2.2	Ice	-49.2	36.4	Ice
-6.3	6.8	"	-57.0	41.0	"
-13.5	12.8	"	-68.3	47.0	"
-20.0	21.0	"	-77.0	52.0	Ice + $(CH_3)_3PO_4$
-27.0	24.5	"	-67.0	60.0	$(CH_3)_3PO_4$
-33.0	27.5	"	-55.4	74.9	"
-41.2	32.5	"	-46.1	100 0	"

Two solid forms of Trimethyl Phosphate were found to show liquid-solid transition temperatures at -46.1 for the stable form α and -62.5 for the metastable form β. (Pagel and Schroeder, 1940).

PROPYL AMINE n $CH_3(CH_2)_2NH_2$

SOLUBILITY OF PROPYL AMINE IN SEVERAL SOLVENTS AT 4.5°
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Solvent	Mol. Fraction $C_3H_7NH_2$ in saturated solution	Solvent	Mol. Fraction $C_3H_7NH_2$ in saturated solution
n Octyl Alcohol	0.408	Glycerol	0.497
Ethylene Glycol	0.465	Diethylene Glycol	0.510
1, 3 Butylene Glycol	0.460	Triethylene Glycol	0.519

The distribution coefficient of Propyl Amine between Ethyl Ether and Water, for concentrations of 55.8 millimols per liter of the ether layer divided by 194 millimols per liter in the water layer is 0.29 at 21° (Collander, 1949).

ISOPROPYL AMINE i $(CH_3)_2CHNH_2$

SOLUBILITY OF ISOPROPYL AMINE IN SEVERAL SOLVENTS AT 4.5°
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Solvent	Mol. fraction $C_3H_7NH_2$ in sat. solution
Ethylene Glycol	0.488
Diethylene Glycol	0.517
Triethylene Glycol	0.552

TRIMETHYL AMINE $(CH_3)_3N$

SOLUBILITY AND SOLVATION OF TRIMETHYL AMINE IN SULFUR DIOXIDE

(Burg, 1948)

Trimethyl Amine and Sulfur Dioxide react instantaneously to form $(CH_3)_3NSO_2$ which is highly soluble in sulfur dioxide

t°	P sat. mm.	Mol. Ratio SO_2 / Amine	Mol. % Amine Dissolved	Apparent Solvation (1)
-17	162	2.50	28.5	2.08
- 8	226	2.30	30.3	1.93
0	296	2.18	31.4	1.84
+ 9.9	394	2.04	32.9	1.74
19.4	494	1.87	34.8	1.61

(1) (mole ratio bound SO_2 to amine)

The distribution coefficient of Trimethyl Amine between Ethyl Ether and Water, for concentrations of 84.4 millimols per liter in the ether layer divided by 183 millimols in the water layer is 0.46 at 21° (Collander, 1949).

ISO PROPANOLAMINE $CH_3CHOHCH_2NH_2$

The distribution coefficient of Iso Propanolamine between Ethyl Ether and Water, for concentrations of 4.8 millimols per liter of the ether layer divided by 1108 millimols per liter of the water layer, is 0.0043 at 21° (Collander, 1949).

PROPANE 1 - SULFAMIDE $C_3H_9O_2NS$

Freezing-point data for mixtures of Propane 1 - Sulfamide and Propane 2 - Sulfamide are given by Asinger, Schmidt, and Ebender, 1942.

1, 2 PROPYLENE DIAMINE $CH_2(NH_2)CH(NH_2)CH_3$

The distribution coefficient of 1, 2 Propylene Diamine between Ethyl Ether and Water, for concentrations of 0.945 millimols per liter of the ether layer divided by 833 millimols per liter of the water layer, is 0.0011 at 20° (Collander, 1949).

1, 3 DIAMINO PROPANOL - 2 $CH_2NH_2CHOHCH_2NH_2$

The distribution coefficient of 1, 3 Diamino Propanol - 2 between Ethyl Ether and Water, for concentrations of 0.245 millimols per liter of ether layer divided by 1225 millimols per liter of the water layer is 0.0002 at 21° (Collander, 1949).

5 - THIAZOLE CARBOXYLIC ACID $C_3H_2NS \cdot COOH$

Freezing-point data are given by Mistow 1948 for:

5 - Thiazole Carboxylic Acid + Benzoic Acid
" " " + 2 - Thiazole Carboxylic Acid
" " " + Nicotinic Acid

ETHYLENE CYANIDE (Succinonitrile) $CNCH_2CH_2CN$

The distribution coefficient of Ethylene Cyanide between Ethyl Ether and Water, for concentrations of 7.41 millimols per liter in the ether layer divided by 23.2 millimols per liter in the water layer is 0.32 at 18° (Collander, 1949).

THIOPHENE $\underline{S}CH:CHCH:\underline{C}H$

FREEZING-POINTS OF MIXTURES OF THIOPHENE AND BENZENE
(Fawcett and Rasmussen, 1945)

t°	d_4^{20}	Mol. % C_4H_4S	Vol. % C_4H_4S	t°	d_4^{20}	Mol. % C_4H_4S	Vol. % C_4H_4S
5.5	0.8790	0.0	0.0	-22.8	0.9768	55.73	52.82
1.3	0.8947	9.54	8.57	-24.8	0.9848	59.89	57.04
-3.5	0.9123	19.84	18.04	-28.8	1.0036	69.73	67.20
-8.6	0.9300	29.99	27.59	-32.5	1.0240	80.13	78.20
-13.0	0.9477	39.93	37.16	-35.6	1.0444	90.20	89.11
-17.02	0.9500	46.04	43.15	-38.3	1.0644	100.00	100.00

Results are also given for the refractive indices and viscosity.

BARBITURIC ACID $\underline{NHCONHCOCH_2}CO$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc } H_2O}$) of Barbituric Acid between Ethyl Ether and Water, for a concentration of 0.8 - 1.8 millimols per liter of the ether layer is 0.026 - 0.023 at 25° (Collander, 1949, quoted from Derner, Markham, and Trimble, 1941).

FUMARIC ACID HOOCCH:CHCOOH

Correction to Vol. 2, 3rd. Ed. of Solubilities of Organic Compounds, p. 215, last table, fourth line of text, the figure 0.645t should be changed to 0.01672t.

SOLUBILITY OF FUMARIC ACID IN MIXTURES OF ORGANIC SOLVENTS AT 20°
(Descamps, 1940)

Results for solvent mixtures of:

Methyl Alcohol + Benzene		Methyl Alcohol + Ethyl Ether	
Wt. % CH_3OH in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent	Wt. % CH_3OH in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100	6.50	100	6.50
71.14	4.67	72.15	7.06
47.68	2.85	51.38	6.48
24.93	1.17	27.21	4.30
0.0 (C_6H_6)	0.0	0.0 ($(C_2H_5)_2O$)	0.28

SOLUBILITY OF FUMARIC ACID IN MIXTURES OF ORGANIC SOLVENTS AT 20° (Con.)

Results for solvent mixtures of:

Ethyl Alcohol + Benzene

Wt. % C_2H_5OH in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100	4.57
76.77	3.65
43.99	2.38
22.77	0.72
0.0 (C_6H_6)	0.0

Ethyl Alcohol + Ethyl Ether

Wt. % C_2H_5OH in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100	4.57
72.68	5.17
69.66	5.29
35.36	3.85
0.0 ($(C_2H_5)_2O$)	0.28

Acetone + Benzene

Wt. % $(CH_3)_2CO$ in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
72.67	1.38
47.91	0.62
46.75	0.45
19.20	0.09

Acetone + Ethyl Ether

Wt. % $(CH_3)_2CO$ in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100.0	2.33
69.14	1.96
33.70	1.11
0.0 ($(C_2H_5)_2O$)	0.28

Methylal + Benzene

Wt. % $CH_2(OCH_3)_2$ in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100.0	0.32
68.73	0.14
50.38	0.08
29.79	0.04
0.0 (C_6H_6)	0.0

Methylal + Ethyl Ether

Wt. % $CH_2(OCH_3)_2$ in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100.0	0.32
73.78	0.35
56.95	0.35
27.78	0.33
0.0 ($(C_2H_5)_2O$)	0.28

Dioxane + Benzene

Wt. % $(CH_2)_4O_2$ in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100.0	1.54
77.73	0.67
52.06	0.31
28.62	0.11
0.0 (C_6H_6)	0.0

Dioxane + Ethyl Ether

Wt. % $(CH_2)_4O_2$ in Solvent	Gms. $C_4H_4O_4$ per 100 gms. Solvent
100.0	1.54
75.48	1.18
53.40	0.91
21.37	0.52
0.0 ($(C_2H_5)_2O$)	0.28

DISTRIBUTION OF FUMARIC ACID BETWEEN WATER AND ORGANIC SOLVENTS

(Marvel and Richards, 1949)

Note. The determinations were made by titrating the acid in the aqueous layer before and after shaking with the organic solvent at about 26°, and calculating the concentration of the latter by the difference. The distribution coefficient K is the concentration in the water layer (approx. 0.16%) divided by the concentration in the organic layer.

DISTRIBUTION OF FUMARIC ACID BETWEEN WATER AND ORGANIC SOLVENTS (Con.)

Solvents in Contact with H_2O layer	Dist. Coef. K $\frac{\text{conc. } H_2O \text{ layer}}{\text{conc. Org. layer}}$	Solvents in Contact with H_2O layer	Dist. Coef. K $\frac{\text{conc. } H_2O \text{ layer}}{\text{conc. Org. layer}}$
n Butanol	0.30	Diisopropylketone	2.8
Ethyl Acetate	0.59	Butyl Acetate	2.1
Ethyl Ether	1.1	Methyl Isobutylketone	0.83
Chloroform	10 +	Methyl Propyl ketone	0.43
Skellysolve B	10 +	Methyl Ethyl ketone	0.33
Carbon Tetra Chloride	10 +	Cyclohexanone	0.29
Benzene	10 +		

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Fumaric Acid between Ethyl Ether and Water, for a concentration of 4.1 - 27.1 millimols per liter of the water layer is 1.0 - 1.3 at 25° (Collander, 1949, quoted from Chandler, 1908).

MALEIC ACID HOOCCH:CHCOOH

100 gms. saturated solution of Maleic Acid in Furfural contains 5.1 gms. $C_4H_4O_4$ at 0°. (Trimble, 1941).

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Maleic Acid between Ethyl Ether and Water, for a concentration of 10.0 to 99.3 millimols per liter in the water layer is 0.056 to 0.10 at 25° (Collander, 1949, quoted from Chandler, 1908).

1, 2-DI BROMO SUCCINIC ACID $C_2H_2Br_2(COOH)_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Dibromo Succinic Acid between Ethyl Ether and Water, for a concentration of 30.2 to 32.7 millimols per liter in the water layer is 17 at 25° (Collander, 1949, quoted from Chandler, 1908).

MONOBROMO SUCCINIC ACID $CH_2CHBr(COOH)_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Monobromo Succinic Acid between Ethyl Ether and Water, for a concentration of 5.6 to 87.9 millimols per liter in the water layer is 1.5 to 2.4 at 25° (Collander, 1949, quoted from Chandler, 1908).

SUCCINIMIDE $(CH_2CO)_2NH$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Succinimide between Ethyl Ether and Water, for a concentration of 500 millimols per liter in the water layer is 0.031 at 23° (Collander, 1949, quoted from Bärlund, 1929).

1, 3-BUTADIENE $CH_2:CHCH:CH_2$

SOLUBILITY OF WATER IN BUTADIENE
(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

t° of Saturation	Saturation		Solubility	
	Pressure, Atmospheres	Time, Hours	Mols. per 100 mols. C_4H_6	Gms. per 100 gms. C_4H_6
7.0	3.7	4.0	0.1466	0.0488
7.5	3.7	3.0	0.1430	0.0476
14.0	4.0	4.0	0.1706	0.0568
15.0	3.7	3.5	0.1700	0.0566
21.0	4.0	4.5	0.1988	0.0662
21.0	3.7	3.5	0.1940	0.0646

Data for the vapor-liquid equilibrium in the system Butadiene-Styrene are given by Wilhelm and Collier, 1948.

GLYCOCOL (Glycine) ANHYDRIDE $\underbrace{NHCOCH_2NHCOCH_2}$

SOLUBILITY OF GLYCOCOL ANHYDRIDE IN WATER AND IN AQUEOUS SOLUTIONS OF SALTS AT 20°
(Meyer and Klemm, 1940)

Aqueous Solutions of	Gms. $C_4H_6O_2N_2$ per 100 cc of Saturated Solution in Aqueous Salt Solutions of Concentration:				
	0.25 mols. per liter	0.5 mols. per liter	1.0 mol. per liter	2.0 mols. per liter	3 mols. per liter
H_2O	--	--	1.43	--	--
LiBr	1.18	0.98	1.12	2.18	3.30
LiI	1.56	1.71	2.10	3.01	3.99
NaCl	1.37	1.44	1.51	1.61	1.80
NaBr	1.42	1.56	1.76	2.18	2.44
NaI	1.55	1.70	2.00	2.94	3.96
KCl	1.40	1.37	1.35	1.45	1.48
KBr	1.32	1.22	1.58	1.74	1.91
KI	1.56	1.72	2.08	2.88	3.90
KF	1.30	1.22	1.10	0.88	0.79

α CROTONIC ACID $CH_3CH:CHCOOH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of α Crotonic Acid between Ethyl Ether and Water, for a concentration of 150 - 760 millimols per liter of the ether layer is 4.2 - 5.3 (Collander, 1949, quoted from Derner, Markham, and Trimble, 1941).

SUCCINIC ACID $COOH(CH_2)_2COOH$

SOLUBILITY OF SUCCINIC ACID IN FURFURAL
(Trimble, 1941)

t°	Gms. $(CH_2)_2COOH$ per 100 gms. sat. sol.
0	2.0
25	3.0
40	7.0

DISTRIBUTION OF SUCCINIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

See Note under Distribution of Fumaric Acid.

Solvents in contact with H_2O layer	Dist. Coef. K conc. H_2O layer / conc. org. layer	Solvents in contact with H_2O layer	Dist. Coef. K conc. H_2O layer / conc. org. layer
n-Butanol	0.83-1.0	Diisopropyl ketone	10 +
Ethyl Acetate	2.7 -1.3	Butyl Acetate	10 +
Ethyl Ether	8.0 -6.0	Methyl Isobutyl ketone	5.4
Chloroform	10 +	Methyl Propyl ketone	2.3
Skellysolve B	10 +	Methyl Ethyl ketone	1.0
Carbon Tetrachloride	10 +	Cyclohexanone	0.91
Benzene	10 +		

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, p. 231, last line, the figures 74° and 44.6 percent should be changed to 55.4° and 26.0 percent.

MALIC ACID (1) $HOOCCH(OH)CH_2COOH$

SOLUBILITY OF (1) MALIC ACID IN MIXTURES OF ORGANIC SOLVENTS AT 20°
(Descamps, 1940)

Results for Solvent Mixtures of:

Methyl Alcohol and Benzene

Wt. % CH_3OH in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100	197.22
75.28	128.05
49.00	Separation
25.71	"
11.83	"
0.0 (C_6H_6)	0.0

Methyl Alcohol and Ethyl Ether

Wt. % CH_3OH in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100	197.22
74.98	146.60
71.10	135.25
51.64	100.78
29.06	61.56
0.0 ($C_2H_5)_2O$	2.70

Ethyl Alcohol and Benzene

Wt. % C_2H_5OH in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100	86.60
71.15	60.74
46.41	30.82
17.51	7.37
0.0 (C_6H_6)	0.0

Ethyl Alcohol and Ethyl Ether

Wt. % C_2H_5OH in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100	86.60
78.30	75.92
44.95	57.52
27.79	38.07
0.0 ($C_2H_5)_2O$	2.70

SOLUBILITY OF (1) MALIC ACID IN MIXTURES OF ORGANIC SOLVENTS AT 20° (Con.)

Results for Solvent Mixtures of:

Acetone and Benzene

Wt. % $(CH_3)_2CO$ in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
88.4	46.4
65.38	21.74
44.34	9.35
20.95	1.33
0.0 (C_6H_6)	0.0

Acetone and Ethyl Ether

Wt. % $(CH_3)_2CO$ in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100.	60.66
80.82	49.17
53.08	31.54
26.93	15.07
0.0 $(C_2H_5)_2O$	2.70

Methylal and Benzene

Wt. % $CH_2(OCH_3)_2$ in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100.	10.31
71.78	3.60
49.77	1.34
22.49	0.21
0.0 (C_6H_6)	0.0

Methylal and Ethyl Ether

Wt. % $CH_2(OCH_3)_2$ in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100.	10.31
67.61	6.78
55.45	5.93
37.23	4.68
0.0 $(C_2H_5)_2O$	2.70

Dioxane and Benzene

Wt. % $(CH_2)_4O_2$ in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100.	74.35
72.18	28.97
50.39	9.12
24.08	0.99
0.0 (C_6H_6)	0.0

Dioxane and Ethyl Ether

Wt. % $(CH_2)_4O_2$ in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
79.13	55.27
55.30	32.15
29.85	12.85
27.42	10.89
0.0 $(C_2H_5)_2O$	2.70

MALIC ACID (dl) $HOOCCH(OH)CH_2COOH$

SOLUBILITY OF (dl) MALIC ACID IN MIXTURES OF ORGANIC SOLVENTS AT 20°
(Descamps, 1940)

Results for Solvent Mixtures of:

Methyl Alcohol and Benzene

Wt. % CH_3OH in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
75.13	53.90
49.30	29.05
40.09	21.30
27.32	Separation
21.74	"
0.0 (C_6H_6)	0.0

Methyl Alcohol and Ethyl Ether

Wt. % CH_3OH in Solvent	Gms. $C_4H_6O_5$ per 100 gms. Solvent
100.	82.7
74.78	63.54
54.76	47.79
23.13	19.02
0.0 $(C_2H_5)_2O$	0.84

SOLUBILITY OF (dl) MALIC ACID IN MIXTURES OF ORGANIC SOLVENTS AT 20° (Con,)

Results for Solvent Mixtures of:

Ethyl Alcohol and Benzene

Wt. % C_2H_5OH in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	45.53
75.52	31.22
44.66	15.14
21.85	5.29
0.0 (C_6H_6)	0.0

Ethyl Alcohol and Ethyl Ether

Wt. % C_2H_5OH in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	45.53
74.46	39.49
45.81	26.57
28.82	17.89
0.0 $(C_2H_5)_2O$	0.84

Acetone and Benzene

Wt. % $(CH_3)_2CO$ in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
69.94	8.23
47.49	3.21
46.75	2.54
19.28	0.33
0.0 (C_6H_6)	0.0

Acetone and Ethyl Ether

Wt. % $(CH_3)_2CO$ in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	17.75
74.75	11.28
53.83	7.25
22.68	2.73
0.0 $(C_2H_5)_2O$	0.84

Methylal and Benzene

Wt. % $CH_2(OCH_3)_2$ in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	3.29
74.25	1.52
49.76	0.59
28.32	0.14
0.0	0.0

Methylal and Ethyl Ether

Wt. % $CH_2(OCH_3)_2$ in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	3.29
77.95	2.65
55.65	2.03
27.67	1.51
0.0 $(C_2H_5)_2O$	0.84

Dioxane and Benzene

Wt. % $(CH_2)_4O_2$ in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	22.70
80.95	10.87
52.89	2.56
27.92	0.38
0.0 (C_6H_6)	0.0

Dioxane and Ethyl Ether

Wt. % $(CH_2)_4O_2$ in Solvent	Gms. $C_4H_6O_5$ per 100gms. Solvent
100.	22.70
76.46	13.14
50.0	6.44
31.73	2.94
0.0 $(C_2H_5)_2O$	0.84

DIGLYCOLIC ACID $O(CH_2COOH)_2$

The distribution coefficient of Diglycolic Acid between Ethyl Ether and Water, for concentrations of 13.4 millimols per liter in the ether layer divided by 447 millimols in the water layer is 0.03 at 21° (Collander, 1949).

TARTARIC ACID $HOOC(CHOH)_2COOH$

SOLUBILITY OF TARTARIC ACID IN WATER
(Sanchez, 1940)

t°	Normality of sat. sol.	Gms. per 100 cc sat. sol.	t°	Normality of sat. sol.	Gms. per 100 cc sat. sol.
5	9.4974	71.2	20	9.9170	74.4
10	9.6390	72.3	25	10.0394	75.3
15	9.7718	73.3	30	10.1754	76.4

100 gms. sat. sol. of Tartaric Acid in Furfural contain 1.2 gms. at 0° and 10.9 gms. at 25° (Trimble, 1941).

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Tartaric Acid between Ethyl Ether and Water, for a concentration of 0.75 to 3.3 millimols per liter of the ether layer is 0.0036 at 25° (Collander, 1949, quoted from Derner, Markham, and Trimble, 1941).

BUTYRONITRILE $CH_3(CH_2)_2CN$

The distribution coefficient for Butyronitrile between Ethyl Ether and Water, for concentrations of 630 millimols in the ether layer divided by 65 millimols per liter in the water layer is 10 at 21° (Collander, 1949).

1-BUTENE, 2-BUTENE $CH_3CH_2CH{:}CH_2$

SOLUBILITY OF WATER IN 1-BUTENE AND IN 2-BUTENE
(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

Results for 1-Butene

t° of Saturation	Saturation: Pressure, Atmospheres	Saturation: Time, hours	Solubility: Mols. per 100 mols. C_4H_8	Solubility: Gms. H_2O per 100 gms. C_4H_8
6.0	3.0	3.0	0.0633	0.0203
7.5	2.9	3.5	0.0764	0.0245
14.0	3.3	3.0	0.0957	0.0307
20.0	3.0	4.0	0.1237	0.0397
21.5	2.9	4.0	0.1253	0.0402

Results for 2-Butene

7.0	2.8	3.0	0.0867	0.0278
7.5	2.4	3.5	0.0876	0.0281
14.0	2.8	3.5	0.1123	0.0360
20.8	2.4	5.5	0.1416	0.0454
21.0	2.8	4.5	0.1343	0.0431

Data for the degree of solvation of Polybutene in 34 pure solvents at room temperature, calculated from the specific viscosity constant at a concentration of 10 gms. polymer per liter, are given by Evans and Young, 1942.

The compositions of coexisting gas and liquid phases in the 1-Butene - n Butane system are given by Sage and Lacey, 1948

The Aniline point of IsoButene is 14.9° and the critical solution temperature with Aniline is 15.80° (Ludeman, 1940).

ISOBUTYLENE (Propene 2-Methyl) $CH_2:C(CH_3)CH_3$

SOLUBILITY OF WATER IN ISOBUTYLENE
(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

t° of Saturation	Saturation		Solubility	
	Pressure, Atmospheres	Time, hours	Mols. H_2O per 100 mols. C_4H_8	Gms. H_2O per 100 gms. C_4H_8
6.0	4.0	3.0	0.0717	0.0230
7.0	4.4	4.0	0.0711	0.0228
7.0	4.2	3.0	0.0671	0.0215
14.0	4.0	3.5	0.0998	0.0320
16.0	4.0	4.0	0.1141	0.0366
21.0	4.4	6.0	0.1209	0.0388
21.0	5.0	6.0	0.1200	0.0385

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, p.241 first table, first column. The designations Heavy Benzene and Light Benzene should be interchanged.

2-BUTANONE (Ethyl Methyl Ketone) $CH_3COC_2H_5$

RECIPROCAL SOLUBILITY OF 2-BUTANONE AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $CH_3COC_2H_5$ per 100 gms.	
	H_2O Rich Phase	$CH_3COC_2H_5$ Rich Phase
20	27.33 (0.9620)	88.41 (0.8353)
25	25.57 (0.9611)	88.28 (0.8322)
30	24.07 (0.9615)	88.15 (0.8270)

The figures in parentheses are the densities at the respective temperatures.

MUTUAL SOLUBILITY OF ETHYL METHYL KETONE, TRICHLORO ETHYLENE AND WATER AT 25°
(Newman, Hayworth, and Treybal, 1949)

Limiting Solubility Concentrations

d_4^{25}	Gms. per 100 gms. Mixture		d_4^{25}	Gms. per 100 gms. Mixture	
	$CH_3COC_2H_5$	$CHCl:CCl_2$		$CH_3COC_2H_5$	$CHCl:CCl_2$
1.3747	6.84	93.10	0.8305	90.0	0.0
1.2676	18.01	81.82	0.9620	24.4	0.0
1.1739	29.13	70.60	0.9665	22.0	0.16
1.0606	43.81	55.56	0.9715	15.04	0.23
0.9763	58.90	39.90	0.9870	8.08	0.40
0.8953	75.40	21.09	--	0.0	0.40

MUTUAL SOLUBILITY OF ETHYL METHYL KETONE, TRICHLORO ETHYLENE AND WATER AT 25°
(Con.)

Conjugate Layers (Tie Line Data) in the Ternary System

Water Rich Layer			Solvent Rich Layer		
	Gms. per 100 gms. Mixture			Gms. per 100 gms. Mixture	
d_4^{25}	$CH_3COC_2H_5$	$CHCl:CCl_2$	d_4^{25}	$CH_3COC_2H_5$	$CHCl:CCl_2$
0.9687	20.71	0.18	0.8606	81.90	13.10
0.9760	16.10	0.22	0.9126	71.65	25.31
0.9831	11.03	0.32	0.9801	58.10	41.68
0.9863	8.50	0.36	1.0710	43.70	56.00
0.9886	6.75	0.38	1.2330	22.10	77.72

MUTUAL SOLUBILITY OF ETHYL METHYL KETONE, 1.1.2-TRICHLORO ETHANE AND WATER AT 25°
(Newman, Hayworth, and Treybal, 1949)

Limiting Solubility Concentration

	Gms. per 100 gms. Mixture			Gms. per 100 gms. Mixture	
d_4^{25}	$CH_3COC_2H_5$	$CH_2ClCHCl_2$	d_4^{25}	$CH_3COC_2H_5$	$CH_2ClCHCl_2$
1.2764	14.65	84.82	0.8305	90.0	0.0
1.1535	29.97	69.20	0.9620	24.4	0.0
1.0554	44.38	54.14	0.9704	20.07	0.1
0.9745	58.38	39.05	0.9774	15.11	0.14
0.9069	71.80	23.91	0.9872	8.06	0.25
0.8531	83.30	9.30	0.9441	2.83	0.37
			--	0.0	0.44

Coniugate Layers, (Tie Line Data) in the Ternary System

Water Rich Layer			Solvent Rich Layer		
	Gms. per 100 gms. Mixture			Gms. per 100 gms. Mixture	
d_4^{25}	$CH_3COC_2H_5$	$CH_2ClCHCl_2$	d_4^{25}	$CH_3COC_2H_5$	$CH_2ClCHCl_2$
0.9733	18.15	0.11	0.8904	75.00	19.92
0.9804	12.78	0.16	0.9720	58.62	38.65
0.9853	9.23	0.23	1.0553	44.38	54.14
0.9902	6.00	0.30	1.1425	31.20	67.80
0.9942	2.83	0.37	1.2554	16.90	82.58
0.9966	1.02	0.41	1.3626	5.58	94.42

MUTUAL SOLUBILITY OF ETHYL METHYL KETONE, CHLORO BENZENE AND WATER AT 25°

(Newman, Hayworth, and Treybal, 1949)

Limiting Solubility Concentration

d_4^{25}	Gms. per 100 gms. Mixture	
	COC_2H_5	C_6H_5Cl
1.0405	15.23	84.46
0.9903	30.14	69.36
0.9446	44.49	54.38
0.9043	58.52	39.34
0.8681	71.95	24.28
0.8406	84.08	9.28

d_4^{25}	Gms. per 100 gms. Mixture	
	$CH_3COC_2H_5$	C_6H_5Cl
0.8305	40.0	0.0
0.9620	24.4	0.0
0.9688	20.1	0.07
0.9764	15.1	0.06
0.9853	8.12	0.14
--	0.0	0.40

Conjugate Layers, (Tie Line Data) in the Ternary System

Water Rich Layer

d_4^{25}	Gms. per 100 gms. Mixture	
	$CH_3COC_2H_5$	C_6H_5Cl
0.9726	18.10	0.05
0.9796	13.10	0.08
0.9841	9.90	0.12
0.9872	7.65	0.16
0.9902	5.52	0.21
0.9928	3.64	0.28

Solvent Rich Layer

d_4^{25}	Gms. per 100 gms. Mixture	
	$CH_3COC_2H_5$	C_6H_5Cl
0.8590	75.52	20.60
0.9041	58.58	30.28
0.9474	48.68	55.15
0.9922	29.65	69.95
1.0324	17.40	82.15
1.0649	8.58	91.18

MUTUAL SOLUBILITY OF ETHYL METHYL KETONE, BUTYL CELLOSOLVE AND WATER AT 25°

(Newman, Hayworth, and Treybal, 1949)

Limiting Solubility Concentrations

Gms. per 100 gms. Mixture	
$CH_3COC_2H_5$	$C_4H_9OCH_2CH_2OH$
90.0	0.0
74.2	6.02
71.0	7.33
55.2	12.4

Gms. per 100 gms. Mixture	
$CH_3COC_2H_5$	$C_4H_9OCH_2CH_2OH$
43.1	11.1
38.35	9.55
25.6	1.60
24.4	0.0

Conjugate Layers, (Tie Line Data) in the Ternary System

Water Rich Layer

Gms. per 100 gms. Mixture		
$CH_3COC_2H_5$	H_2O	$C_4H_9OCH_2CH_2OH$
27.8	67.3	4.0
29.5	66.0	4.5
23.7	59.2	7.1
29.9	65.1	5.0
25.7	72.4	1.9

Ketone Rich Layer

Gms. per 100 gms. Mixture		
$CH_3COC_2H_5$	H_2O	$C_4H_9OCH_2CH_2OH$
50.1	29.7	11.2
56.1	31.7	12.2
49.7	38.1	12.2
56.5	31.4	12.1
74.4	18.8	5.8

The authors also give data for the binary and ternary liquid-vapor phase equilibria and also densities and refractive indices of this system.

RECIPROCAL SOLUBILITY OF ETHYL METHYL KETONE, NORMAL HEXANE AND WATER AT 25°

(Treybal and Vondrak , 1949)

See note under Reciprocal Solubility of Acetone, n Hexane and Water p. 606.

Limiting Solubility Concentrations

d_4^{25}	Gms. per 100 gms. Mixture		d_4^{25}	Gms. per 100 gms. Mixture	
	$CH_3COC_2H_5$	H_2O		$CH_3COC_2H_5$	H_2O
0.6853	10.20	0.0	0.8305	90.00	10.00
0.7012	25.07	0.0	0.9919	3.98	96.02
0.7174	39.68	0.28	0.9848	8.02	91.98
0.7303	49.84	0.44	0.9820	11.83	88.17
0.7439	59.65	0.86	0.9766	15.88	84.42
0.7602	68.53	2.03	0.9703	20.03	79.97
0.7857	80.45	4.20	0.9622	23.28	76.72
0.8041	86.36	6.31	0.9620	24.40	75.60

Tie Line Equilibrium Concentrations

Lower Water Rich Layer		Upper Ketone Rich Layer	
Gms. per 100 gms. Mixture		Gms. per 100 gms. Mixture	
$CH_3COC_2H_5$	H_2O	$CH_3COC_2H_5$	H_2O
6.20	93.80	11.00	0.0
10.71	89.29	28.32	0.2
12.73	87.27	41.79	0.4
15.00	85.09	55.38	0.9
16.98	83.02	69.51	2.0

RECIPROCAL SOLUBILITY OF ETHYL METHYL KETONE, n HEPTANE AND WATER AT 25°

(Treybal and Vondrak, 1949)

See note under Reciprocal Solubility of Acetone, Normal Hexane and Water p. 606.

Limiting Solubility Concentrations

d_4^{25}	Gms. per 100 gms. Mixture		d_4^{25}	Gms. per 100 gms. Mixture	
	$CH_3COC_2H_5$	H_2O		$CH_3COC_2H_5$	H_2O
0.6871	10.05	0.0	0.7869	82.17	3.68
0.7017	24.96	0.0	0.8069	86.55	7.20
0.7177	39.88	0.0	0.8305	90.00	10.00
0.7301	50.19	0.24	0.9892	5.82	94.18
0.7436	60.05	0.59	0.9801	12.51	87.49
0.7572	68.25	0.69	0.9697	19.67	80.33
0.7725	75.41	1.28	0.9620	24.40	75.60

RECIPROCAL SOLUBILITY OF ETHYL METHYL KETONE, HEPTANE AND WATER AT 25° (Con.)

Tie Line Equilibrium Concentrations

Lower Water Rich Layer		Upper Ketone Rich Layer	
Gms. per 100 gms. Mixture		Gms. per 100 gms. Mixture	
$CH_3COC_2H_5$	H_2O	$CH_3COC_2H_5$	H_2O
7.81	92.19	12.09	0.0
11.94	88.06	27.79	0.0
14.92	85.08	40.73	0.1
18.01	81.99	65.10	0.5
19.37	80.63	74.81	1.0

ETHER bis (2-CHLOROETHYL) (Chlorex) $(ClCH_2CH_2)_2O$

CRITICAL SOLUTION TEMPERATURES OF CHLOREX WITH SEVERAL HYDROCARBONS
(Woodbury, Smith, and Tetewsky, 1944)

Critical Solution Temperature	System
10.85°	Chlorex + n Pentane
12.70°	" + n Hexane
16.50°	" + n Heptane
20.67°	" + n Octane
24.00°	" + n Nonane
47.93°	" + n Hexadecane

FREEZING-POINTS OF MIXTURES OF CHLOREX AND METHYL ALCOHOL
(Tschamler, Richter, and Wettig, 1949)

t°	Mol. Fraction $(ClCH_2CH_2)_2O$	t°	Mol. Fraction $(ClCH_2CH_2)_2O$
-97.5	0.0	-53.2	0.675
-61.0	0.121	-52.9	0.818
-55.0	0.298	-51.2	0.922
-53.7	0.559	-47.0	1.000

FREEZING-POINTS OF MIXTURES OF CHLOREX AND n PROPYL ALCOHOL
(Tschamler, Richter, and Wettig, 1949)

t°	Mol. Fraction $(ClCH_2CH_2)_2O$	Solid Phase	t°	Mol. Fraction $(ClCH_2CH_2)_2O$	Solid Phase
-126.5	0.0	C_3H_7OH	-33	0.403	Liquid Layer
- 62.2	0.060	"	-32.9	0.450	Crit. Sol. Temp.
- 58.8	0.078	"	-34.6	0.648	Liquid Layer
- 54.4	0.096	"	-36.9	0.732	" "
- 51.9	0.145	Liquid Layer	-48.0	0.913	$(ClCH_2CH_2)_2O$
- 40.9	0.203	" "	-47.8	0.956	"
- 35.0	0.298	" "	-46.9	1.000	"

Freezing-point data are also given for:

Chlorex	+ Cyclohexane	Tschamler, 1948
"	+ Methyl Cyclohexane	" "
"	+ Normal Octane	Tschamler, Wettig, and Richter, 1949
"	+ Iso Octane	" " " "
"	+ Pseudo Cumene	Tschamler, 1948a

BUTYRIC ACID $CH_3CH_2CH_2COOH$

DISTRIBUTION OF BUTYRIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration of the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.16%) divided by the concentration in the organic solvent layer.

Results for K in:

$\frac{H_2O}{\text{n Butanol}}$	$\frac{H_2O}{\text{Ethyl Acetate}}$	$\frac{H_2O}{\text{Ethyl Ether}}$	$\frac{H_2O}{\text{Chloroform}}$	$\frac{H_2O}{\text{Skellysolve B}}$
0.14-0.16	0.18-0.19	0.19-0.22	1.2-1.7	10+

ETHYLENE GLYCOL (p Dioxane) $\underbrace{OCH_2CH_2OCH_2CH_2}$

A saturated solution of Water in p Dioxane contains 0.207 mol. fraction H_2O at 4.5° (Copley, Ginsberg, Zellhoeffer, and Marvel, 1941).

EQUILIBRIUM IN THE SYSTEM DIOXANE, BENZALDEHYDE AND WATER AT 25°
(Siggia and Hanna, 1949)

See note under the system Ethyl Alcohol, Vinyl Ether and Water p.600.

Gms. per 100 gms. Mixture		
C_6H_5CHO	$C_4H_8O_2$	H_2O
41.0	54.0	5.02
30.6	64.4	5.0
16.4	71.8	11.7
9.96	84.7	5.3
4.99	59.7	35.4

The compositions of the vapor and liquid phases at various temperatures and at 0.1 atmosphere pressure for the systems:

Ethylene Glycol + Water
" " + Diethylene Glycol
Diethylene Glycol + Water
" " + Triethylene Glycol
" " + Ethylene Glycol + H_2O

are given by Skripach and Temkin, 1946

ETHYL ACETATE $CH_3COOC_2H_5$

SOLUBILITY OF ETHYL ACETATE IN AQUEOUS SOLUTIONS OF 3,5,5, TRIMETHYL HEXYL SODIUM SULFATE AT 25°

(Bruner, 1949)

Wt. % conc. of Aqueous 3,5,5, Trimethyl Hexyl Sodium Sulfate	Gms. $CH_3COOC_2H_5$ dissolved per 100 gms. Aqueous Solvent
1.0	8.0
5.0	10.0
10.0	18.0
25.0	60.0

SOLUBILITY OF ETHYL ACETATE IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES

(Booth and Emerson, 1949)

Gms. Na Sulfonate per 100 gms. Aqueous Solvent	cc Ethyl Acetate per 100 cc Aqueous Solvent in: Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	at 25°	at 60°	at 25°	at 60°	at 25°	at 60°	at 25°	at 60°
0.0	8.80	7.40	8.80	7.40	8.80	7.40	8.80	7.40
5.0	8.74	7.86	9.80	8.39	9.21	7.88	10.00	8.03
10.0	8.86	8.14	14.60	13.10	10.20	8.88	11.30	10.10
20.0	10.50	9.56	26.60	26.40	14.30	13.30	17.70	16.60
32.	13.60	13.10	---	---	---	---	---	---
34.6	---	---	64.80	67.40	---	---	---	---
40.	---	---	---	---	28.30	27.90	42.60	43.60

The distribution coefficient of Ethyl Acetate between Ethyl Ether and Water, for concentrations of 660 millimols in the ether layer divided by 78 millimols per liter in the water layer is 8.5 at 20° (Collander, 1949)

Results for densities, viscosities, refractive indices, boiling points and surface tensions for the ternary system Ethyl Acetate + Butyl Alcohol + Toluene are given by Litkenhous, Van Arsdale, and Hutchinson, Jr., 1940.

ACETYL METHYL CARBINOL (Acetoin) $CH_3CHOHCOCH_3$

Liquid-Vapor equilibrium data for the system Acetyl Methyl Carbinol-Water are given by Blom and Efron, 1945.

DIMETHYL GLYOXIME $CH_3C(:NOH)C(:NOH)CH_3$

100 gms. sat. solution of Dimethyl Glyoxime in Furfural contain 0.016 gm. at 25°. (Trimble, 1941).

α OXY ISOBUTYRIC ACID $(CH_3)_2COHCOOH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of α Oxy Isobutyric Acid between Ethyl Ether and Water, for a concentration of 15 to 180 millimols per liter of the ether layer is 0.22-0.26 at 25°. (Collander, 1949, quoted from Derner, Markham, and Trimble, 1941).

METHYL LACTATE $CH_3CHOHCOOCH_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Methyl Lactate between Ethyl Ether and Water, for a concentration of 1400 millimols per liter in the water layer is 0.37 at 19°. (Collander, 1949).

N, N, -DIMETHYL ACETAMIDE $CH_3CON(CH_3)_2$

The solubility of Water in N.N.-Dimethyl Acetamide at 4.5° is 0.232 mol. fraction H_2O in the saturated solution. (Copley, Ginsberg, Zellhoeffer, and Marvel, 1941).

n BUTYRAMIDE $CH_3CH_2CH_2CONH_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of n Butyramide between Ethyl Ether and Water, for a concentration of 250-500 millimols per liter of the water layer is 0.058 (Collander, 1949, quoted from Bärlund, 1929).

AMINO BUTYRIC ACIDS, α, β, γ normal and α iso $C_4H_9O_2N$

SOLUBILITY OF AMINO BUTYRIC ACIDS IN WATER AT 25°

(Mason, 1947)

Amino Butyric Acid	Formula	d_{25} sat. sol.	Gms. Amino Butyric Acid per 100 gms. H_2O
α Amino n Butyric Acid	$CH_3CH_2CH(NH_2)COOH$	1.0456	21.05
β " " " "	$CH_3CH(NH_2)CH_2COOH$	---	125.0
γ " " " "	$NH_2CH_2CH_2CH_2COOH$	---	130.0
α Amino Isobutyric Acid	$(CH_3)_2C(NH_2)COOH$	1.0312	15.28

The distribution coefficient of α Amino n Butyric Acid between Ethyl Ether and Water, for concentrations of 0.043 millimols per liter of the ether layer divided by 1640 millimols per liter of the water layer is 0.0000026 at 21°. (Collander, 1949).

n BUTANE $CH_3(CH_2)_2CH_3$

SOLUBILITY OF WATER IN BUTANE
(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

t° of Saturation	Saturation: Pressure, Atmospheres	Saturation: Time, Hours	Solubility: Mols. H_2O per 100 mol. C_4H_{10}	Solubility: Gms. H_2O per 100 gms. C_4H_{10}
5.0	2.7	4.0	0.00775	0.00240
5.5	2.8	2.5	0.00985	0.00305
14.5	3.1	6.0	0.01227	0.00389
15.0	3.4	3.8	0.01453	0.00459
20.0	6.4	4.0	0.02002	0.00620
20.0	3.4	2.5	0.02220	0.00688
21.0	3.4	3.5	0.02430	0.00753

The composition of the coexisting liquid and gas phases in the n Butane-Water system for the three phase region at temperatures above 100°F and at pressures from 52 to 637 lbs. per sq. inch, are given by Reamer, Olds, Sage, and Lacey, 1944.

Diagrams and complete numerical results for the coniugate liquid phase compositions in the ternary system n Butane, Furfural and Water at temperatures from 100° to 200°F. and pressures from about 50 to 186 lbs. per sq. inch are given by Griswold, Klecka, and West, 1948.

The liquid-vapor P-V-T-X equilibrium relations in the system n Butane-n Heptane are given by Kay, 1941.

Phase equilibrium in the condensed region of the system n Butane-Decane are given by, Reamer, Sage, and Lacey, 1946.

The aniline point of n Butane is 83.1° and the critical solution temperature with aniline is 84.1°, (Ludeman, 1940).

ISOBUTANE $(CH_3)_3CH$

SOLUBILITY OF WATER IN ISOBUTANE
(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

t° of Saturation	Saturation: Pressure, Atmospheres	Saturation: Time, Hours	Solubility: Mols. H_2O per 100 mols. C_4H_{10}	Solubility: Gms. H_2O per 100 gms. C_4H_{10}
7.0	3.4	3.3	0.00898	0.00278
18.0	3.9	4.3	0.02060	0.00638
19.0	4.0	3.5	0.02220	0.00688
21.8	4.0	5.0	0.02695	0.00835

The aniline point of Isobutane is 107.5° and the C.S.T. with aniline is 109.0°. (Ludeman, 1940).

PIPERAZINE $\underline{NHCH_2CH_2NHCH_2CH_2}$

The distribution coefficient of Piperazine between Ethyl Ether and Water, for concentrations of 0.41 millimols per liter in the ether layer divided by 798 millimols per liter in the water layer is 0.00052 at 20° (Collander, 1949).

BUTYL ALCOHOLS (n) $CH_3(CH_2)_2CH_2OH$, (sec.) $CH_3CH_2CHOHCH_3$, (tert.) $(CH_3)_3COH$

SOLUBILITY OF n BUTYL ALCOHOL (1-BUTANOL) IN AQUEOUS SOLUTIONS OF 3, 5, 5 TRIMETHYL HEXYL SODIUM SULFATE AT 25°

(Bruner, 1949)

Wt. % Concentration of Aq. 3,5,5 Trimethyl Hexyl Sodium Sulfate	Gms. n $CH_3(CH_2)_2CH_2OH$ dissolved per 100 gms. Solvent
1.0	10.
5.0	58.
10.0	Soluble in all proportions

SOLUBILITY OF BUTYL ALCOHOLS IN TRIETHYLENE TETRAMINE AND IN HEXAMETHYLENE DIAMINE, EACH SEPARATELY AT 4.5°

(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Alcohol	Mol. Fraction C_4H_9OH in Saturated Solution in:	
	Triethylene Tetramine	Hexamethylene Diamine
n Butyl, $CH_3(CH_2)_2CH_2OH$	0.345	0.321
sec. Butyl, $CH_3CH_2CHOHCH_3$	0.360	0.385
tert. Butyl, $(CH_3)_3COH$	0.376	0.364

DISTRIBUTION OF BUTYL ALCOHOLS BETWEEN ETHYL ETHER AND WATER AT 20°

(Collander, 1949)

Alcohol	Millimols Alcohol per Liter		Dist. Coef. K $\frac{\text{conc. Ether Layer}}{\text{conc. } H_2O \text{ Layer}}$
	Ethyl Ether Layer	Water Layer	
n Butyl $CH_3(CH_2)CH_2OH$	1860	242	7.7
sec. Butyl $CH_3CH_2CHOHCH_3$	1743	390	4.5
tert. Butyl $(CH_3)_3COH$	1364	634	2.2
Isobutyl $(CH_3)_2CHCH_2OH$	1786	259	6.9

RECIPROCAL SOLUBILITY OF n BUTYL ALCOHOL, BUTYL ETHER AND WATER AT 15°

(Lazzari, 1948)

Mixtures of weighed amounts of n Butyl Alcohol and Butyl Ether were titrated with Water to permanent turbidity.

Wt. % $(C_4H_9)_2O$ in C_4H_9OH + $(C_4H_9)_2O$ Mixture	Gms. H_2O to Produce Turbidity in 100 gms. Organic Mixture	d of Sat. Solution	Gms. per 100 gms. Sat. Sol.		
			$(C_4H_9)_2O$	C_4H_9OH	H_2O
0.0	23.6	0.8498	--	80.80	19.20
10.0	17.9	0.8383	8.48	76.34	15.18
20.0	13.0	0.8283	17.69	77.79	11.51
30.0	10.1	0.8200	27.25	63.57	9.17
40.0	7.8	0.8118	37.11	55.65	7.24
50.0	5.8	0.8040	47.26	47.26	5.48
60.0	4.2	0.7980	57.58	38.39	4.03
70.0	2.8	0.7916	68.09	29.18	2.73
80.0	1.8	0.7855	78.58	19.65	1.77
90.0	0.75	0.7789	89.33	9.92	0.74
100.0	--	0.7732	100.0	--	--

RECIPROCAL SOLUBILITY OF n BUTYL ALCOHOL, TOLUENE AND WATER AT 20°

(Shanahan, 1948)

Wt. % $C_6H_5CH_3$ in C_4H_9OH + $C_6H_5CH_3$ Mixtures	Gms. H_2O to Produce Turbidity in 100 gms. of Organic Mixture	Refractive Index n_D^{20} of Saturated Solution
0.0	24.8	1.3914
26.2	10.7	1.4179
51.6	4.65	1.4436
76.2	1.52	1.4688
100.0	< 0.1	1.4946

These results yield curves which may be used for estimating the composition of unknown mixtures of the three components

The Vapor-Liquid equilibrium in the system n Butyl Alcohol - Acetaldehyde-Dibutyl Acetal are given by Connor, Elving, and Steingiser, 1948.

2, 3-BUTANEDIOL (2, 3-Butylene Glycol) $CH_3CH(OH)CH(OH)CH_3$

FREEZING-POINTS OF MIXTURES OF BUTANEDIOLS AND WATER

(Knowlton, Schieltz, and MacMillon, 1946)

The original results are presented only in the form of a diagram from which the following approximate values were read.

Freezing Points of Mixtures of:

Laevo 2, 3-Butanediol + H_2O			Meso 2, 3-Butanediol + H_2O		
t°	Wt. % $C_4H_{10}O_2$	Solid Phase	t°	Wt. % $C_4H_{10}O$	Solid Phase
0	0	Ice	0	0	Ice
-3	10	"	-3	10	Ice + Compound
-13	30	"	+10	20	Compound
-35	50	"	16	40	"
-51	60	"	15	60	"
-67	67	Ice + $C_4H_{10}O_2$	2	80	"
-27	80	$C_4H_{10}O_2$	-12	86	Compound + $C_4H_{10}O_2$
-4	90	"	0	90	$C_4H_{10}O_2$
+20	100	"	36	100	"

The Compound contains about 45% meso 2, 3 Butanediol and 55% H_2O

The distribution coefficient of 2, 3 Butylene Glycol between Ethyl Ether and Water, in terms of conc. in Ether layer divided by conc. in water layer is 0.029 at room temperature. (Collander, 1949, quoted from Wartiovaara, 1942).

GLYCEROL MONOMETHYL ETHER $C_4H_{10}O_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glycerol Monomethyl Ether between Ethyl Ether and Water, for a concentration of 1000 millimols per liter of the water layer is 0.019 at room temperature. (Collander, 1949, quoted from Collander and Bärlund, 1933).

DIETHYLENE GLYCOL $C_4H_{10}O_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Diethylene Glycol between Ethyl Ether and Water, for a concentration of 1000 millimols per liter in the water layer is 0.004 at room temperature. (Collander, 1949).

i ERYTHRITOL $(CH_2OHCHOH)_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Erythritol between Ethyl Ether and Water, for a concentration of 2000 millimols per liter of the water layer is 0.00011 at room temperature. (Collander, 1949, quoted from Collander and Bärlund, 1933).

BUTAN 1, 3 AND 1, 4 DISULFOCHLORIDE $C_4H_8O_4Cl_2S_2$

Freezing-Point data for mixtures of Butan 1, 3 and 1, 4 Disulfochloride are given by Asinger, Ebender, and Böch, 1942.

DIETHYLAMINE $(C_2H_5)_2NH$

RECIPROCAL SOLUBILITY OF DIETHYL AMINE, TOLUENE AND WATER AT 24.4°
(Webb and Franke, 1949)

Limiting Solubility Concentrations

Gms. per 100 gms. Mixture		
H_2O	$(C_2H_5)_2NH$	$C_6H_5CH_3$
1.0	15.8	83.2
2.5	21.5	76.0
5.0	28.0	67.0
10.0	33.9	56.1
20.0	38.0	42.0
30.0	39.3	30.7
40.0	38.9	21.1
50.0	37.3	12.7
60.0	33.8	6.2
70.0	27.4	2.6
80.0	19.1	0.9
90.0	9.7	0.3

Conjugate Layer (Tie Line) Concentrations

Gms. per 100 gms. Mixture		
H_2O	$(C_2H_5)_2NH$	$C_6H_5CH_3$
45.1	9.0	45.9
37.2	27.5	35.3
30.5	42.0	27.5
30.5	40.8	28.7
24.0	53.5	22.5
25.0	52.5	22.5
19.7	62.0	18.3
12.6	74.1	13.2
5.7	87.4	6.9
1.2	97.1	1.7

DISTRIBUTION OF DIETHYL AMINE BETWEEN TOLUENE AND WATER
(Webb and Franke, 1949)

Results at:

19.9° Gm. Mols. $(C_2H_5)_2NH$ per liter		24.4° Gm. Mols. $(C_2H_5)_2NH$ per liter		29.9° Gm. Mols. $(C_2H_5)_2NH$ per liter	
H_2O layer	$C_6H_5CH_3$ layer	H_2O layer	$C_6H_5CH_3$ layer	H_2O layer	$C_6H_5CH_3$ layer
0.270	0.146	0.055	0.034	0.187	0.159
0.550	0.310	0.210	0.142	0.484	0.422
0.745	0.425	0.325	0.228	0.625	0.556
1.048	0.628	0.564	0.398	0.900	0.807
		0.806	0.584		

The distribution coefficient of Diethyl Amine between Ethyl Ether and Water, for concentrations of 34.2 millimols per liter in the ether layer divided by 64.6 millimols per liter in the water layer is 0.53 at 18°. (Collander, 1949).

The solubility of Diethyl Amine at 4.5° in:

Ethylene Glycol is 0.371 mol. fraction of the saturated solution.
Glycerol is 0.572 mol. fraction of the saturated solution.
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941).

BUTYL AMINES (n) $CH_3(CH_2)_2CH_2NH_2$, (i, tert) $(CH_3)_3CNH_2$, (sec) $CH_3CH(NH_2)CH_2CH_3$

SOLUBILITY OF BUTYL AMINES IN ORGANIC SOLVENTS AT 4.5°
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Amine		Solvent	Mol. Fraction Amine in Saturated Solution
(n) Butyl Amine	(n) $C_4H_9NH_2$	Ethylene Glycol	0.400
(i) " "	(i) "	" "	0.381
(s) " "	(s) "	" "	0.397
(n) Butyl Amine	(n) $C_4H_9NH_2$	Diethylene Glycol	0.384
"	"	Triethylene Glycol	0.405
"	"	Tetra Ethylene Glycol	0.410
"	"	Hexamethylene Diamine	0.144
"	"	Triethylene Tetramine	0.145

DIETHANOLAMINE $HN(CH_2CH_2OH)_2$

The distribution coefficient of Diethanolamine between Ethyl Ether and Water, for concentrations of 0.5 millimols per liter in the ether layer, divided by 921 millimols per liter in the water layer, is 0.00054 at room temperature. (Collander, 1949).

TETRAMETHYLENE DIAMINE (Putrescine) $NH_2(CH_2)_4NH_2$

The distribution coefficient of Tetramethylene Diamine between Ethyl Ether and Water, for concentrations of 0.595 millimols per liter of the ether layer, divided by 468 millimols per liter of the water layer, is 0.0013 at 23°. (Collander, 1949).

HEXACHLORO CYCLOPENTEN KETONES C_5Cl_6O

The freezing-points of mixtures of the two isomeric Hexachloro Cyclopenten Ketones are given by Engelsma and Gerding, 1949.

5 - BROMO, 2 - THIOPHENE CARBOXYLIC ACID $BrC_4H_2S{\cdot}COOH$

Freezing-point data are given by Mislow, 1948, for

5 - Bromo, 2 - Thiophene Carboxylic Acid + Benzoic Acid.
" " " " + p Toluic Acid.
" " " " + 5,- Methyl, 2 - Thiophene Carboxylic Acid.

FURFURAL C_4H_3OCHO

RECIPROCAL SOLUBILITY OF FURFURAL AND WATER
(Griswold, Klecka, and West, 1948)

t° F	t° C	Gms. H_2O per 100 gms. C_4H_3OCHO Phase	Gms. C_4H_3OCHO per 100 gms. H_2O Phase
100	37.78	6.4	9.5
125	51.67	7.8	10.9
150	65.56	9.7	12.5
175	79.44	12.3	14.5
200	93.33	15.2	19.3
248.9	120.50	Critical solution temperature	

SOLUBILITY OF FURFURAL IN AQUEOUS SOLUTIONS OF SULFATES

(Curtis and Hatt, 1948)

The temperature of miscibility was taken as the point at which all turbidity disappeared on slowly warming mixtures of Furfural with various amounts of aqueous sulfate solutions.

Results for:

5.016% Aqueous Na_2SO_4		4.383% Aqueous $MgSO_4$		4.836% Aqueous Al_2SO_4		5.0% Aqueous $ZnSO_4$	
t°	Wt. % C_4H_3OCHO	t°	Wt. % C_4H_3OCHO	t°	Wt. % C_4H_3OCHO	t°	Wt, % C_4H_3OCHO
64.6	7.78	73.8	8.35	83.3	10.52	104.2	14.37
90.2	9.87	97.7	11.52	92.3	12.42	138.3	22.00
100.2	11.00	110.0	14.65	101.4	14.31	165.0	38.50
112.2	13.56	124.1	18.81	112.7	17.61	169.0	45.65
124.8	16.48	134.3	24.26	116.1	19.30	167.	71.15
135.1	20.19	139.7	28.00	125.3	24.20		
142.7	24.24	143.3	30.70	134.0	31.55		
146.6	26.54	145.8	31.45	136.9	34.55		
151.2	29.24	169.0	31.46	139.4	37.90		
154.6	32.05	170.0	31.68	143.3	41.40		
158.6	35.41	179.8	34.4	160.0	44.0		
160.8	37.30	171.3	35.2				
163.1	38.70	172.	37.8				
167.4	41.06	175.	41.3				
171.2	42.20	180.	48.35				
173.2	42.76	182.	59.6				
185.7	44.60	170	70.7				

Results are also given for Aqueous 1.168% Na_2SO_4 and 10.0% Na_2SO_4.

The authors obtained results for the reciprocal solubility of Furfural and Water which agree with those of Evans and Aylesworth, 1926.

Results for the boiling-points and equilibrium, liquid and vapor compositions in the Furfural - Water system, at pressures between 4.55 Kg. per cm and 9.83 Kg. per cm, are given by Curtis and Hatt, 1948.

Results for the liquid - vapor equilibrium in the system Furfural - Furfuryl Alcohol in terms of mol. fraction of C_4H_3OCHO in the liquid and vapor phases at 25 mm pressure, are given by Dunlop and Trimble, 1940.

PYRAZINE CARBOXYLIC ACID $C_4H_3N_2COOH$

Freezing-point data are given by Mislow, 1948 for:

Pyrazine Carboxylic Acid + Benzoic Acid
" " " + Picoline
" " " + Nicotinic Acid
" " " + Iso-nicotinic Acid

2-THIOPHENE CARBOXYLIC ACID $C_4H_3S \cdot COOH$

Freezing-point data are given by Mislow, 1948 for:

2 - Thiophene Carboxylic Acid + Benzoic Acid
" " " + 2 - Pyrrol Carboxylic Acid
" " " + Furoic Acid
3 - " " " + Benzoic Acid

FURAN CARBOXYLIC ACID $C_4H_3O \cdot COOH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Furan Carboxylic Acid between Ethyl Ether and Water, for a concentration of 79 - 340 millimols per liter of the ether layer is 3.8 - 4.5 at 25°. (Collander, 1949, quoted from Derner, Markham, and Trimble, 1941).

2-FUROIC ACID (Pyromucic Acid) $C_4H_3O \cdot COOH$

Freezing-point data are given by Mislow, 1948 for:

Furoic Acid + Benzoic Acid
" " + 2-Thiophene Carboxylic Acid
" " + 2-Pyrrol Carboxylic Acid

PYRIDINE C_5H_5N

EQUILIBRIUM IN THE SYSTEM PYRIDINE, BENZENE AND WATER AT 25°
(Siggia and Hanna, 1949)

The determinations were made by a method in which it was necessary to determine chemically only one component. Mixtures of the two miscible components were titrated with the third until appearance of turbidity. The percentage of each component was calculated and the corresponding points plotted on a triangular diagram.

Gms. per 100 gms. of Mixture		
H_2O	C_5H_5N	C_6H_6
5.18	59.8	34.9
5.24	81.7	13.1
12.28	75.5	12.2
15.06	80.1	4.93
34.72	60.5	4.69

The distribution coefficient of Pyridine between Ethyl Ether and Water, for concentrations of 354 millimols per liter in the ether layer divided by 302 millimols per liter in the water layer is 1.2 at 18°. (Collander, 1949).

Freezing-point data for mixtures of Pyridine with ortho, with meta and with para phenyl phenol are given by Haslet and Morrow, 1942.

Freezing-point data for mixtures of Pyridine and each of the following compounds: Formamide, N,-Phenyl Formamide, N, N, Diethyl Acetamide, N, N, Diphenyl Acetamide, N, N, Diphenyl Formamide, N, Methyl Diacetamide and N, Methyl Phthalamide are given by Stephanow, Van der Werf, and Sisler, 1948.

PYRIDINE SULFATE $C_5H_5N \cdot H_2SO_4$

Results for the system Pyridine, Sulfuric Acid and Water at 20°, showing the formation of the compound $C_5H_5N \cdot H_2SO_4$ are given by Peakin, 1940, in the form of a triangular diagram without stating the terms or giving the numerical data from which the curve was drawn.

PYRIDINE OXALATE $C_5H_5N \cdot (COOH)_2$

100 gms. Abs. C_2H_5OH dissolve 1.3 gm. Pyridine Oxalate at 18 - 20° C.
100 gms. 96% " " 2.38 gms. " " " "
(Grigorowsky and Kimen, 1945)

PYRIDINE PHTHALATE $C_5H_5N \cdot C_6H_4(COOH)_2$

100 gms. Abs. C_2H_5OH dissolve 24.5 gms. Pyridine Phthalate at 18 - 20°
100 gms. $(C_2H_5)_2CO$ " 20.74 " " " " "

2, PYRROL CARBOXYLIC ACID $C_4H_4N \cdot COOH$

Freezing-point data are given by Mislow, 1948 for:

2, - Pyrrol Carboxylic Acid + Benzoic Acid
" " " + Furoic Acid

AMINO PYRIDINE $NH_2C_5H_4N$

The distribution coefficient of Amino Pyridine between Ethyl Ether and Water, for concentrations of 26.2 millimols per liter of the ether layer divided by 34.2 millimols per liter of the water layer is 0.77 at 21°. (Collander, 1949).

ITACONIC ACID $HOOCC(:CH_2)CH_2COOH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Itaconic Acid between Ethyl Ether and Water, for concentrations of 3.9 to 61.5 millimols per liter of the water layer is 0.29 - 0.33 at 25°. (Collander, 1949, quoted from Chandler, 1908)

CITRACONIC ACID $CH_3C(COOH):CHCOOH$

The distribution coefficient of Citraconic Acid between Ethyl Ether and Water, for concentrations of 28.9 millimols per liter of the ether layer divided by 141 millimols per liter of the water layer is 0.20 at 19°. (Collander, 1949).

ISOPRENE $CH_2:CHC(CH_3):CH_2$

SOLUBILITY OF ISOPRENE IN AQUEOUS SOLUTIONS OF POTASSIUM OLEATE AT 20°
(Yurzhenko and Mintz, 1945)

Wt. % K Oleate in Aqueous Solvent	cc Isoprene dissolved per 100 cc Aqueous Solvent			
		(1)	(2)	(3)
0.25	--	0.45	0.68	0.50
0.50	--	0.63	0.75	0.75
0.75	0.65	--	--	--
1.0	--	0.9	1.7	1.33
1.5	3.5	3.22	3.0	1.55
3.0	9.0	10.1	8.4	5.5

(1) Aqueous solvent contained also 0.08 gm. equiv. of Na_2CO_3
(2) " " " " 0.16 " " " " "
(3) " " " " 0.32 " " " " "

LEVULINIC ACID $CH_3COCH_2CH_2COOH$

The distribution coefficient of Levulinic Acid between Ethyl Ether and Water, for concentrations of 123 millimols per liter in the ether layer divided by 478 millimols per liter in the water layer is 0.26 at 20°. (Collander, 1949).

GLUTARIC ACID $(CH_2)_3(COOH)_2$

SOLUBILITY OF GLUTARIC ACID IN WATER
(Attane and Doumani, 1949)

t°	Gms. $(CH_2)_3(COOH)_2$ per 100 gms. H_2O	t°	Gms. $(CH_2)_3(COOH)_2$ per 100 gms. H_2O
3.4	46.7	23.9	130.0
10.4	70.4	28.3	159.6
14.0	83.0	45.8	297.
18.0	104.1		

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glutaric Acid between Ethyl Ether and Water, for concentrations of 5.6 to 28 millimols per liter in the water layer is 0.26 at 25°. (Collander, 1949, quoted from Chandler, 1908).

DISTRIBUTION OF GLUTARIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvents at about 26° and calculating the conc. in the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.16%) divided by the conc. in the organic solvent layer.

Results for K in:

$\frac{H_2O}{\text{n Butanol}}$	$\frac{H_2O}{\text{Ethyl Acetate}}$	$\frac{H_2O}{\text{Ethyl Ether}}$	$\frac{H_2O}{\text{Chloroform}}$	$\frac{H_2O}{\text{Skellysalve B}}$
0.59 - 0.62	1.5	4.2 - 3.9	10+	10+

HYDROXY PROLINE $C_4H_7N(OH)COOH$

100 cc Acetic Acid dissolve 1.67 gm. $C_4H_7N(OH)COOH$ at 18°

100 cc Butyric Acid dissolve 0.0075 gm. $C_4H_7N(OH)COOH$ at 18°

(Przylecki, Kasprzyle-Czaykowska, 1938)

PROLINE PHOSPHOTUNGSTATE $(C_5H_9O_2N)_3H_8PO_4 \cdot 12WO_3 \cdot 2 \cdot 5H_2O$

SOLUBILITY OF PROLINE PHOSPHOTUNGSTATE IN AQUEOUS SOLUTIONS AT 22°

(Van Slyke, Hiller, and Dillon, 1942)

The determinations were made both by precipitation and by resolution of the Phosphotungstate in the aqueous solvents. Varying ratios of excess Phosphotungstate Acid (PTA) and of Proline, and also of concentrations of Hydrochloric Acid were used.

Original Solvent		Additional millimols per liter		Solubility of $C_4H_7N(OH)COOH \cdot PTA \cdot 2.5H_2O$ in millimols per liter	
Normality HCl	Gms. PTA per liter	$C_4H_7N(OH)COOH$	PTA	By Precipitation	By Resolution
1.0	50	87	46	36.6	25.5
1.0	50	174	75	41.5	25.0
1.0	50	348	133	48.2	25.3
0.25	50	-	-	-	21.1
0.5	50	-	-	-	23.3
1.0	50	-	-	-	25.3
2.0	50	-	-	-	20.8
3.0	50	-	-	-	16.4

Results for the effect of temperature on the solubility of Proline Phosphotungstate in aqueous 0.25 normal HCl, determined by the resolution method, are given in the form of a diagram from which the following approximate values were read.

t°	Solubility of Proline·PTA expressed as Mgs. Amino Acid N per liter
0	130
10	190
20	260
25	330
30	400
40	600

l (+) GLUTAMIC ACID $C_3H_5(NH_2)(COOH)_2$

SOLUBILITY OF l (+) GLUTAMIC ACID IN AQUEOUS SOLUTIONS OF GLYCINE, DIGLYCINE AND TRIGLYCINE AT 25°

(Sexton and Dunn, 1947)

Results for Aqueous Solutions of:

Glycine		Diglycine		Triglycine	
Moles per 1000 gms. H_2O		Moles per 1000 gms. H_2O		Moles per 1000 gms. H_2O	
Glycine	(1)	Diglycine	(1)	Triglycine	(1)
0.09566	0.06184	0.00	0.05912	0.0	0.05912
0.3072	0.07131	0.09681	0.06472	0.06773	0.06986
0.5134	0.08137	0.5217	0.09973	0.1336	0.08125
0.8308	0.09048	1.076	0.1375	0.2003	0.08987
1.032	0.09674	1.586	0.1675	0.2827	0.10025
1.594	0.1135				
2.180	0.1307				
2.821	0.1475				
3.475	0.1617				

(1) = 1 (+) Glutamic Acid

n ALKYL n ALKOXY PROPIONATES $CH_3OCH_2CH_2COOCH_3$ etc.

SOLUBILITY OF n ALKYL n ALKOXY PROPIONATES IN WATER AT APPROXIMATELY 25°

(Rehberg, Dixon, and Fisher, 1947)

Compound	Gms. Compound dissolved per 100 cc H_2O	Compound	Gms. Compound dissolved per 100 cc H_2O
$CH_3OCH_2CH_2COOCH_3$	75.0 (approx.)	$CH_3OCH_2CH_2C_4H_9$	0.98
$C_2H_5OCH_2CH_2COOCH_3$	11.2	$C_4H_9OCH_2CH_2CH_3$	0.82
$C_2H_5OCH_2CH_2COOC_2H_5$	5.5	$C_3H_7OCH_2CH_2C_3H_7$	0.36
$CH_3OCH_2CH_2COOC_3H_7$	3.2	$CH_3OCH_2CH_2C_5H_{11}$	0.29
$C_3H_3OCH_2CH_2COOCH_3$	3.4	$C_5H_{11}OCH_2CH_2C_5H_{11}$	0.08

CYCLOPENTANE $\underline{CH_2CH_2CH_2CH_2}CH_2$

Equilibrium temperatures in the system Cyclopentane and 2, 2 Dimethyl Butane are given by Fink, Cines, Frev, and Ashton, 1947.

2-METHYL BUTENE-2 $CH_3CH{:}C(CH_3)_2$

The Critical Solution Temperature of 2-Methyl Butene-2 is 11.0°. (Ludeman, 1940, quoted from Brame and Hunter, 1927).

3, METHYL BUTANONE-2 $CH_3COCH(CH_3)_2$

RECIPROCAL SOLUBILITY OF 3, METHYL BUTANONE-2 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $CH_3COCH(CH_3)_2$ per 100 gms.:	
	H_2O Rich Phase	Methyl Butanone Rich Phase
20	6.53 (0.9908)	97.61 (0.8328)
25	6.08 (0.9901)	97.43 (0.8284)
30	5.68 (0.9890)	97.24 (0.8238)

PENTANONE-2 $CH_3CO(CH_2)_2CH_3$

RECIPROCAL SOLUBILITY OF PENTANONE-2 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $CH_3CO(CH_2)_2CH_3$ per 100 gms.	
	H_2O Rich Phase	Pentanone-2 Rich Phase
20	5.95 (0.9903)	96.70 (0.8147)
25	5.51 (0.9897)	96.52 (0.8103)
30	5.18 (0.9887)	96.32 (0.8059)

PENTANONE - 3 $C_2H_5COC_2H_5$

RECIPROCAL SOLUBILITY OF PENTANONE-3 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_2H_5COC_2H_5$ per 100 gms:	
	H_2O Rich Phase	Pentanone-3 Rich Phase
20	5.08 (0.9925)	98.55 (0.8195)
25	4.81 (0.9915)	98.38 (0.8150)
30	4.50 (0.9901)	98.17 (0.8108)

The figures in parentheses are the densities at the respective temperatures.

ISOVALERIC ACID $(CH_3)_2CHCH_2COOH$

The distribution coefficient of Isovaleric Acid between Ethyl Ether and Water, for concentrations of 108 to 1076 millimols per liter of the ether layer divided by 6.2 to 54.6 millimols per liter of the water layer is 17-20 at about 20°. (Collander, 1949).

TRIMETHYL ACETIC ACID (Pivalic Acid) $(CH_3)_3CCOOH$

The distribution coefficient of Trimethyl Acetic Acid between Ethyl Ether and Water, for concentrations of 362 millimols per liter of the ether layer divided by 11.3 millimols per liter of the water layer is 32 at 17°. (Collander, 1949).

MONOACETIN (Glycerol Monoacetin) $CH_2OHCHOHCH_2OOCCH_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Monoacetin between Ethyl Ether and Water, for a concentration of 500 millimols per liter in the water layer is 0.041 at 20°. (Collander, 1949, quoted from Bärlund, 1929)

ARABINOSE $C_5H_{10}O_5$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Arabinose between Ethyl Ether and Water, for a concentration of about 1300 millimols per liter in the water layer,.is 0.000038 at 18°. (Collander, 1949).

PIPERIDINE $(CH_2)_5NH$

The distribution coefficient of Piperidine between Ethyl Ether and Water, for concentrations of 35.7 millimols per liter in the ether layer divided by 62.6 millimols per liter in the water layer is 0.57 at 18°. (Collander, 1949).

ISOVALERAMIDE $(CH_3)_2CHCH_2CONH_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Isovaleramide between Ethyl Ether and Water, for concentrations of 250 to 500 millimols per liter in the water layer is 0.17 at 24°. (Collander, 1949, quoted from Bärlund, 1929).

(dl) NORVALINE $C_5H_{11}O_2N$

THE SOLUBILITY OF NORVALINE IN AQUEOUS SOLUTIONS OF GLYCINE AT 25°
(Sexton and Dunn, 1947)

$d_{25°}$	pH	Mols. per 1000 gms. H_2O	
		Glycine	Norvaline
1.0101	6.96	0.0	0.7204
1.0242	6.65	0.5107	0.7178
1.0357	6.49	1.033	0.7081
1.0576	6.35	1.878	0.6946
1.0701	6.28	2.546	0.6489
1.0745	6.28	2.746	0.6133

VALINE $(CH_3)_2CHCH(NH_2)COOH$

100 cc of Butyric Acid dissolve 0.056 gm. $C_5H_{11}O_2N$ at 18°
(Przylecki and Kasprzyle-Czaykowska, 1938)

METHIONINE $CH_2SCH_2CH_2CH(NH_2)COOH$

100 cc of Acetic Acid dissolve 1.75 gm. $C_5H_{10}O_2NS$ at 18°
(Przylecki and Kasprzyle-Czaykowska, 1938)

DIETHYL UREA (uns) $(C_2H_5)_2NCONH_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of uns. Diethyl Urea between Ethyl Ether and Water, for a concentration of about 500 millimols per liter in the water layer is 0.019 at 21°. (Collander, 1949, quoted from Bärlund, 1929).

n PENTANE $CH_3(CH_2)_3CH_3$

SOLUBILITY OF WATER IN n PENTANE AT 1.0 ATMOSPHERE PRESSURE
(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

t° of Saturation	Solubility	
	Mols. H_2O per 100 mols. C_5H_{12}	Gms. H_2O per 100 gms. C_4H_{12}
5.5	0.0144	0.0036
15.0	0.0245	0.0061
24.8	0.0479	0.0119

The Aniline point of n Pentane is 70.7° (Ludeman, 1940, quoted from Evans, 1937).

ISO PENTANE (Butane 2-Methyl) $(CH_3)_2CHCH_2CH_3$

SOLUBILITY OF WATER IN ISO PENTANE AT 1.0 ATMOSPHERE PRESSURE
(Black, Joris, and Taylor, 1948)

t° of Saturation	Saturation Time, Hours	Solubility	
		Mols. H_2O per 100 mols. C_5H_{12}	Gms. H_2O per 100 gms. C_5H_{12}
6.0	3.5	0.01777	0.00443
6.0	4.5	0.01762	0.00440
15.3*	-	0.0263	0.0066
20.0	4.0	0.03613	0.00902
20.0	8.0	0.03764	0.00940
20.5	4.0	0.04020	0.01001
21.3*	-	0.0383	0.0096
21.8*	-	0.0390	0.0097

*Determinations made in a glass apparatus.

The Critical Solution Temperature of Iso Pentane with Aniline is 77.8°. (Ludeman, 1940, quoted from Evans, 1937).

TETRATHIO ORTHO CARBONATE of METHYL $C(SCH_3)_4$

The freezing-points of mixtures of $C(SCH_3)_4$ and Naphthalene are given by Baker and Perdok, 1943.

GLYCEROL α MONOETHYL ETHER $C_2H_5OCH_2CHOHCH_2OH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glycerol α Monoethyl Ether between Ethyl Ether and Water, for concentrations of 500 to 1000 millimols per liter in the water layer is 0.026 at 23°. (Collander, 1949 quoted from Bärlund, 1929).

DIETHYLENE GLYCOL MONOMETHYL ETHER $CH_3OCH_2CH_2OCH_2CH_2OH$

The distribution coefficient of Diethylene Glycol Monomethyl Ether between Ethyl Ether and Water, for concentrations of 33.9 millimols per liter in the ether layer divided by 915 millimols per liter in the water layer is 0.037 at 20°. (Collander, 1949).

PENTAERYTHRITOL $C(CH_2OH)_4$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Pentaerythritol between Ethyl Ether and Water, for a concentration of about 370 millimols per liter in the water layer is 0.0003 at 18°. (Collander, 1949).

PENTAMETHYLENE DIAMINE (Cadaverine) $H_2N(CH_2)_5NH_2$

The distribution coefficient of Pentamethylene Diamine between Ethyl Ether and Water, for concentrations of 0.21 millimols liter in the water layer divided by 84.1 millimols per liter in the ether layer is 0.0025 at 18°. (Collander, 1949).

HEXACHLORO BENZENE C_6Cl_6

SOLUBILITY OF HEXACHLORO BENZENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction C_6Cl_6 in Saturated Solution
-8.77	0.0077
19.29	0.0102
29.93	0.0147
41.88	0.0209

PENTACHLORO BENZENE C_6HCl_5

SOLUBILITY OF PENTACHLORO BENZENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction C_6HCl_5 in Saturated Solution
-8.77	0.0277
19.29	0.0382
29.93	0.0583
41.88	0.0814

PICRYL CHLORIDE $(NO_2)_3C_6H_2Cl$

Freezing-points of mixtures of Picryl Chloride and Trinitro Toluene are given by Kofler and Branstatter, 1943.

PICRIC ACID (2, 4, 6 Trinitro Phenol) 2, 4, 6, $C_6H_2OH(NO_2)_3$

EQUILIBRIUM IN THE SYSTEM 2, 4, 6 TRINITRO PHENOL - WATER
(Efremov, 1940)

t°	Gms. 2,4,6 $C_6H_2OH(NO_2)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 2,4,6 $C_6H_2(OH)(NO_2)_3$ per 100 gms. sat. sol.	Liquid Phase
7.1	1.01	Ice	108.6	8.43	Water rich
33.3	1.74	"	117.9	9.38	" "
62.9	3.31	"	126.5	10.20	" "
83.9	4.82	"	146.3	13.08	" "
104.8	tr.pt.8.2	Ice + liquid	152.4	14.11	" "
104.8	" 95.8	liquid + Picric Acid	165.3	16.00	" "
111.8	97.23	Picric Acid	160.4	93.95	Picric Acid rich
117.8	98.8	" "	158.7	94.25	" " "
122.4	100.0	" "	132.9	95.29	" " "

The Critical Solution temperature of the liquid phase was not reached.

Freezing-point data are given for mixtures of:

Picric Acid + Trinitro Toluene (Campbell and Prichard, 1947)
" " + Dinitro Phenol " " " "
" " + Dinitro Phenol + Picramide (Campbell, Prichard, Campbell, and Boyd, 1947).
" " + α Picoline (Pushin and Kozuhar, 1947)
" " + Quinoline " " " "
" " + α, α, Lutidine " " " "
" " + Acetamide " " " "
" " + Ethyl Urethane " " " "
" " + Cinnamic Acid " " " "
" " + α Nitro Naphthalene " " " "
" " + p Nitro Toluene " " " "
" " + Tetranitro Pentaerythrite " " " "
" " + Benzophenone " " " "

TRINITRO RESORCINOL (Styphnic Acid) 2, 4, 6 $C_6H(OH)_2(NO_3)_3$

FREEZING-POINTS IN THE SYSTEM STYPHNIC ACID - WATER
(Efremov, 1940)

t°	Gms. 2,4,6 $C_6H(OH)_2(NO_2)_3$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 2,4,6 $C_6H(OH)_2(NO_2)_3$ per 100 gms. sat. sol.	Solid Phase
6.1	0.59	Ice	85.0	2.40	Ice
35.7	0.74	"	100.1	3.94	"
56.9	1.02	"	115.2	5.85	"
71.2	1.52	"	123.2	7.02	"

DIBROMO BENZENE $C_6H_4Br_2$

Freezing-points of the binary and ternary mixtures of Dibromo Benzene, Aniline and Phenol are given by Chichokin and Muskina, 1938.

Freezing-points of the binary and ternary mixtures of p Dibromo Benzene, p Dichloro Benzene and p Chlorobromo Benzene are given by Campbell and Prodan, 1948.

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 341 The paragraph beginning, The Critical Solution Temperature should be changed to the Demixing Temperature. This applies also to the last sentence on page 342 and to a statement near the middle of page 346.

BROMO IODO BENZENE C_6H_4BrI

Freezing-points of mixtures of Bromo Iodo Benzene and p Diiodo Benzene are given by Brandstatter, 1943a.

QUINONE $O{:}C_6H_4{:}O$

The distribution coefficient of Quinone between Ethyl Ether and Water, for concentrations of 8.93 to 27.1 millimols per liter of the ether layer divided by 2.92 to 8.41 millimols per liter of the water layer is 0.32 at 19°. (Collander, 1949, quoted from Landoldt and Börnstein).

DINITRO BENZENE $C_6H_4(NO_2)_2$

Freezing-point data are given for mixtures of:

Dinitro Benzene + Naphthylamine (Kofler, 1942)
" " + Hexogen (Kofler, 1949)
" " + Neno (Campbell and Kushnarov, 1947)

DINITRO PHENOL 2, 4 $C_6H_3(OH)(NO_2)_2$

EQUILIBRIUM IN THE SYSTEM DINITRO PHENOL - WATER
(Efremov, 1940)

t°	Gms. 2,4 $C_6H_3OH(NO_2)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 2,4 $C_6H_3OH(NO_2)_2$ per 100 gms. sat. sol.	Liquid Phase
54.5	0.137	Ice	122.2	2.62	H_2O rich
75.8	0.301	"	139.3	3.92	"
87.4	0.587	"	157.3	6.02	"
96.2	1.22	"	169.3	8.03	"
105.5tr.pt.	2.4	Ice + liquid	174.6	94.02	2,4 $C_6H_3OH(NO_2)_2$ rich
105.5 "	97.0	liquid + 2,4 $C_6H_3OH(NO_2)_2$	158.2	95.10	"
107.6	98.1	2,4 $C_6H_3OH(NO_2)_2$ "	138.0	96.0	"
111.4	100.0		111.8	96.54.	

The critical solution temperature of the liquid phase was not reached.

Freezing-points of mixtures of Dinitro Phenol and Trinitro Toluene are given by Campbell and Fritchard, 1947.

DINITRO RESORCINOL, 2, 4 and 4, 6 $C_6H_2(OH)_2(NO_2)_2$

EQUILIBRIUM IN THE SYSTEM 2, 4 DINITRO RESORCINOL - WATER

(Efremov, 1940)

t°	Gms. 2, 4 $C_6H_2(OH)_2(NO_2)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 2, 4 $C_6H_2(OH)_2(NO_2)_2$ per 100 gms. sat. sol.	Liquid Phase
57.7	0.63	Ice	111.7	10.05	H_2O rich
69.5	1.51	"	140.5	14.38	"
90.0	5.0	"	160.8	20.02	"
95.1	tr.pt. 8.7	Ice + Liquid	166.6	30.10	"
95.1	" 71.8	Liquid + 2, 4 $C_6H_2(OH)_2(NO_2)_2$	167.0	C.S.T. 37.7	Crit. Solution
100.3	82.63	2, 4 $C_6H_4(OH)_2(NO_2)_2$	164.1	50.0	2, 4 $C_6H_2(OH)_2(NO_2)_2$ rich
107.7	89.18	"	151.5	60.18	"
122.7	94.97	"	130.3	65.11	"
142.0	100.0	"	102.9	70.08	"

FREEZING-POINTS IN THE SYSTEM 4, 6. DINITRO RESORCINOL - WATER

(Efremov, 1940)

t°	Gms. 4, 6 $C_6H_2(OH)_2(NO_2)_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 4, 6 $C_6H_2(OH)_2(NO_2)_2$ per 100 gms. sat. sol.	Solid Phase
77.0	0.04	Ice	133.8	0.71	Ice
90.5	0.08	"	137.0	1.01	"
116.6	0.32	"	143.8	1.41	"
126.1	0.52	"	148.6	1.82	"

CHLORO BENZENE C_6H_5Cl

RECIPROCAL SOLUBILITY OF CHLORO BENZENE AND PERFLUORO - METHYL CYCLOHEXANE ($C_6H_{11}CF_3$)

(Hildebrand and Cochran, 1949)

The sealed tube method was used and the consolute temperatures observed during slow cooling of the mixtures.

t°	Volume Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of C_6H_5Cl	t°	Volume Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of C_6H_5Cl
86.9	0.909	0.950	123.5	0.400	0.561
110.4	0.833	0.905	108.1	0.231	0.365
126.8	0.600	0.742	92.9	0.167	0.277
126.7	0.500	0.657	65.7	0.091	0.161

*Measured at 25°

Diagrams and numerical results for the liquid-vapor equilibrium in the system Chloro Benzene - Aniline, using a modified equilibrium still, are given by Coulter, Lindsay, and Baker, 1941.

o CHLORO PHENOL o C_6H_4OHCl

Freezing-point data for mixtures of o Chloro Phenol and each of the three isomeric Picolines are given by Lemmerman, Davidson, and Van der Werf, 1946.

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, p. 355, last sentence, change Critical solution temperature to demixing temperature. On page 356, eliminate the sentence The critical solution temperature of mixtures of p Chloro Phenol and Naphthalene is 58.2°. (Lecat, 1928).

NITRO BENZENE $C_6H_5NO_2$

SOLUBILITY OF NITRO BENZENE IN ORDINARY WATER AND IN DEUTERIUM WATER

(Vermillion, Werbel, Saylor, and Gross, 1941)

t°	In Ordinary Water		In Deuterium Water	
	Gms. $C_6H_5NO_2$ per 1000 gms. H_2O	Mol. $C_6H_5NO_2$ per mol. H_2O	Gms. $C_6H_5NO_2$ per 1000 gms. D_2O	Mol. $C_6H_5NO_2$ per mol. D_2O
0	1.66	0.000243	--	--
6	1.70	0.000249	1.43	0.000233
30	2.06	0.000302	1.70	0.000277
50	2.64	0.000387	2.13	0.000347
60	3.12	0.000457	--	--

RECIPROCAL SOLUBILITY OF NITRO BENZENE, ANILINE AND WATER AT 25°

(Smith, Poecking, and Barber, 1949)

Limiting Solubility Compositions

d_4^{25}	Gms. per 100 gms. Mixture			d_4^{25}	Gms. per 100 gms. Mixture		
	$C_6H_5NH_2$	$C_6H_5NO_2$	H_2O		$C_6H_5NH_2$	$C_6H_5NO_2$	H_2O
1.0179	94.95	0.0	5.05	1.1841	5.09	94.60	0.34
1.0244	91.45	4.72	3.83	1.187	4.88	94.70	0.33
1.0322	86.55	10.33	3.12	1.1982	0.00	99.74	0.26
1.0468	77.70	19.90	2.40		Water Layer		
1.0785	58.85	39.59	1.56				
1.1129	39.80	59.29	0.91				
1.153	19.90	79.60	0.50	--	3.62	0.00	96.38
1.1730	10.00	89.61	0.39	--	0.00	0.20	99.80

Distribution Data at 25°

Original Mixture			Organic Layer			Gms. $C_6H_5NH_2$ per 100 gms. H_2O Layer
Gms. per 100 gms. Mixture			Gms. per 100 gms. Mixture			
$C_6H_5NH_2$	$C_6H_5NO_2$	H_2O	$C_6H_5NH_2$	$C_6H_5NO_2$	d_4^{25}	
41.40	8.59	50.01	80.1	2.57	1.0425	3.06
33.39	16.88	49.73	65.0	1.72	1.0679	2.55
24.86	25.85	49.29	47.7	1.11	1.0990	1.92
16.74	33.50	49.76	32.2	0.77	1.1277	1.40
11.95	38.04	50.01	22.5	0.56	1.1468	1.05
8.34	42.11	49.55	15.5	0.48	1.1614	0.80
5.45	44.56	49.99	10.0	0.37	1.1741	0.53

CRITICAL SOLUTION TEMPERATURES OF NITRO BENZENE WITH SEVERAL HYDROCARBONS

(Woodbury, Smith, and Tetewsky, 1944)

C. S. t.	System
25.15	$C_6H_5NO_2$ + n Pentane
20.60	" + n Hexane
25.61	" + 2-Methyl Pentane
33.50	" + 2,2 - Dimethyl Butane
19.48	" + n Heptane
23.08	" + 2,2,3-Trimethyl Butane (Triptane)
20.68	" + n Octane
30.38	" + 2,2,4, Trimethyl Pentane
21.78	" + n Nonane
38.52	" + n Hexadecane (Cetane)

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 358 2nd. paragraph. Change The critical solution temperature to The demixing temperature.

Freezing-points are given by Chichokin and Muskina, 1938, for mixtures of:

Nitro Benzene + Acetanilide
" " + " + Urethane
" " + Allyl thio Urea + Urethane
" " + " " " + Allyl isothio cyanate

NICOTINIC ACID C_5H_4NCOOH

SOLUBILITY OF NICOTINIC ACID IN WATER AND IN AQUEOUS SOLUTIONS OF p AMINO BENZENE SULFONAMIDE (Sulfanilamide)

(Caronna, 1948)

t°	Gms. C_5H_4NCOOH per 100 gms. Saturated Solution in Aqueous Solutions of $H_2NC_6H_4SO_2NH_2$ of:					
	0 Wt. %	0.50 Wt. %	1.0 Wt. %	2.0 Wt. %	3.0 Wt. %	4.0 Wt. %
16	32.98	35.21	35.88	36.15	36.92	37.18
28	44.96	45.15	45.35	46.22	46.72	47.34

Note - The authors designation "g o/oo" of Nicotinic Acid dissolved, probably should be interpreted as gms. per 1000 gms. saturated solution instead of gms. per 100 gms. saturated solution.

SOLUBILITY OF NICOTINIC ACID IN WATER AND IN ORGANIC SOLVENTS

(Hertelendi, 1948)

t°	Gms. C_5H_4NCOOH per 100 cc Saturated Solution in:					
	H_2O	CH_3OH	C_2H_5OH	$CH_3COOC_2H_5$	$(CH_3)_2CO$	$CHCl:CCl_2$
0	-	0.63	0.64	-	-	-
1	1.51	-	-	-	-	-
20	1.80	1.00	0.96	-	-	0.02
23	-	-	-	0.60	0.39	-
42	3.30	-	-	-	-	-
45	-	2.00	2.01	-	-	-
58	-	-	-	0.98	1.02	-
60	4.82	-	-	-	-	-
62	-	3.45	3.40	-	-	-
70	-	-	-	-	-	0.06
80	7.41	-	-	-	-	-
88	9.15	-	-	-	-	-

Freezing-point data are given by Bailey, Bright, and Jasper, 1945, for:

Nicotinic Acid + Benzoic Acid
Nicotineamide + Ascorbic Acid

Freezing-point data are given by Mislow, 1948 for:

Nicotinic Acid + Benzoic Acid
" " + Picolinic Acid
" " + Pyrazine Carboxylic Acid
" " + 5-Thiazo Carboxylic Acid
" " + Iso Nicotinic Acid
Iso Nicotinic Acid + Picolinic Acid
" " " + Pyrazine Carboxylic Acid
" " " + Benzoic Acid

PICOLINIC ACID C_5H_4NCOOH

Freezing-point data are given by Mislow, 1948 for:

Picolinic Acid + Benzoic Acid
" " + Pyrazine Carboxylic Acid
" " + Isonicotinic Acid

NITRO PHENOLS o, m and p $C_6H_4OHNO_2$

Results for the solubility of o, m and p Nitro Phenols in Water, in agreement with those of Sedgwick, Spurrel, and Davis, 1915 (See Solubilities 3rd. Ed. Vol. 2, p. 361) are given by Efremov, 1940.

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of o, m and p Nitro Phenol each separately, between Ethyl Ether and Aqueous 0.001 n H_2SO_4, for a concentration of 100 millimols in the ether layer, was found to be 150 for the o, 160 for the m and 110 for the p compound at 20°. (Collander, 1949)

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 367, first line. Change The critical solution temperature to The demixing temperature of etc.

Freezing-point data are given for:

o Nitro Phenol + Ketocineole (2-Oxycineole) (Brambella, 1942)
p Nitro Phenol + Naphthalene (Campbell and Campbell, 1941)
p Nitro Phenol + Cellobiose α) Octacetate (Marsden, Bambridge, and Morris, 1943)

NITRO RESORCINOLS 2- and 4- $C_6H_3(OH)_2NO_2$

EQUILIBRIUM IN THE SYSTEM 2 - NITRO RESORCINOL - WATER

(Efremov, 1940)

t°	Gms. 2- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 2- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Liquid Phase
28.4	0.131	Ice	82.9	1.91	H_2O rich
54.9	0.567	"	92.3	2.43	"
67.2	0.983	"	108.6	3.32	"
78.9 (tr.	1.83	Ice + liquid	118.6	4.02	"
78.9 pt.)	96.9	Liquid + 2- $C_6H_3(OH)_2NO_2$	132.7	5.09	"
			128.4	95.11	2-$C_6H_3(OH)_2NO_2$ rich
81.1	97.52	2 - $C_6H_3(OH)_2NO_2$	115.9	95.50	"
83.4	98.63	"	100.0	96.2	"
84.8	100.0	"			

The critical solution temperature of the liquid phase was not reached.

EQUILIBRIUM IN THE SYSTEM 4 - NITRO RESORCINOL - WATER

t°	Gms. 4- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 4- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Liquid Phase
18.3	0.68	Ice	62.7	10.17	H_2O rich
47.5	2.32	"	68.4	15.12	"
52.3	4.50	"	72.9	23.07	"
54.4 (tr.	6.4	Ice + liquid	74.4 C.s.t.	32.7	Critical Solution
54.4 pt.)	62.0	Liquid + 4- $C_6H_3(OH)_2NO_2$	73.3	40.02	4- $C_6H_3(OH)_2NO_2$ rich
58.7	69.57	4 - $C_6H_3(OH)_2NO_2$	69.8	49.67	"
70.2	84.1	"	66.7	54.14	"
96.5	94.27	"	60.1	58.87	"
112.2	100.0	"	57.0	60.45	"

p NITRO HYDROQUINONE p $C_6H_3(OH)_2NO_2$

EQUILIBRIUM IN THE SYSTEM p NITRO HYDROQUINONE - WATER

(Efremov, 1940)

t°	Gms. p $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. p $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Liquid Phase
-0.6	0.50	Ice	93.8	20.0	H_2O rich
30.2	1.08	"	110.9	25.0	"
49.6	3.20	"	119.2	35.0	"
59.1	7.50	"	120.2 C.s.t.	42.0	Critical Solution
66.5 (tr.	17.5	Ice + liquid	118.8	50.0	p $C_6H_3(OH)_2NO_2$ rich
67.0 pt.)	75.7	p $C_6H_3(OH)_2NO_2$ + liquid	113.0	60.0	"
			89.8	70.0	"
70.0	80.0	p $C_6H_3(OH)_2NO_2$	68.8	75.0	"
88.5	90.0	"			
131.2	100.0	"			

NITRO PYROCATECHOLS 3- and 4- $C_6H_3(OH)_2NO_2$

EQUILIBRIUM IN THE SYSTEM 3- NITRO PYROCATECHOL - WATER

(Efremov, 1940)

t°	Gms. 3- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 3- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Liquid Phase
14.4	0.841	Ice	61.3	5.94	H_2O rich
35.1	2.02	"	86.8	9.76	"
45.8	3.82	"	101.3	19.00	"
49.9 (tr.	5.00	Ice + liquid	105.3	30.11	"
49.9 pt.)	79.00	Liquid + 3- $C_6H_4(OH)_2NO_2$	105.3 C.s.t.	39.9	Critical Solution
			102.8	51.13	3-$C_6H_3(OH)_2NO_2$ rich
54.9	84.29	3-$C_6H_4(OH)_2NO_2$	90.8	67.51	"
75.7	97.51	"	68.3	74.89	"
85.0	100.0	"	55.3	77.78	"

FREEZING-POINTS IN THE SYSTEM 4- NITRO PYROCATECHOL - WATER

t°	Gms. 4- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Solid Phase	t°	Gms. 4- $C_6H_3(OH)_2NO_2$ per 100 gms. sat. sol.	Solid Phase
-3.1	1.02	Ice	71.2	50.01	4-$C_6H_3(OH)_2NO_2 \cdot 4H_2O$
-8.7	4.43	"	80.5 tr.t.	62.5	" + 4-$C_6H_3(OH)_2NO_2$
-12.0	7.04	"	84.7	66.67	4-$C_6H_3(OH)_2NO_2$
-17.5 (Eut.	no. 8	Ice + 4-$C_6H_3(OH)_2NO_2 \cdot 4H_2O$*	90.7	71.6	"
			105.5	79.3	"
+14.3	20.12	4-$C_6H_3(OH)_2NO_2 \cdot 4H_2O$	132.7	90.2	"
41.3	30.0	"	168.0	100.0	"
58.5	39.61	"			

*Unstable

BENZENE C_6H_6

SOLUBILITY OF WATER IN BENZENE AT 1.0 ATMOSPHERE PRESSURE

(Black, Joris, and Taylor, 1948)

The determinations were made with the use of Tritium Oxide as a tracer.

t°	Mols. H_2O per 100 mols. C_6H_6	Gms. H_2O per 100 gms. C_6H_6
10	0.1305	0.030
20	0.1846	0.0425
20	0.1942	0.0445
26	0.2344	0.0540

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 368, 8th and 11th lines from bottom page, Change Solvent Benzol to Solvent Naphtha. p. 369, 16th line from bottom of page, Change the paragraph beginning "More recent determinations etc." to Determinations of the equilibrium in the Benzene-Phenol system at 80° and at 90° etc.

SOLUBILITY OF BENZENE IN AQUEOUS SOLUTIONS OF THE SODIUM SALTS OF NORMAL FATTY ACIDS AT 16°

(Durand, 1946)

The results are presented in the form of a diagram from which the following approximate figures were taken.

Normal fatty acid	cc C_6H_6 dissolved per liter of Aqueous Solution of the Na Salt of Fatty Acid of Normality			
	1.on	2.on	3.on	4.on
C_3 Propionic	1.65	1.65	1.65	1.65
C_4 Butyric	1.65	1.65	1.8	3.7
C_5 Valeric	1.65	3.7	10.0	19.0
C6 Caproic	1.65	9.0	27.0	50.0
C_7 Heptoic	4.0	20.0	60.0	--
C8 Caprylic	12.0	50.0	--	--
C_9 Nonylic	25.0	90.0	--	--
C_{10} Capric	48.0	--	--	--
Results are also given for:				
Cyclohexane Carboxylic	1.65	5.0	22.0	50 +
Phenyl Acetic	1.65	4.0	16.0	38

SOLUBILITY OF BENZENE IN AQUEOUS SOLUTIONS OF POTASSIUM LAURATE AND POTASSIUM MYRISTATE AT 25°

(Stearns, Oppenheimer, Simon, and Harkins, 1947)

A series of ampules containing a constant concentration of the soap (K laurate or myristate) and increasing amounts of the oil (benzene) were shaken for 48 hours, after which the turbidity was measured by means of a photometer. A plot was made of turbidity against amount of oil and the sharp break in the curve considered as the saturation point.

Results for Aqueous Solutions of:

Potassium Laurate		Potassium Myristate	
Gms. per 100 gms. Solution		Gms. per 100 gms. Solution	
K Laurate	C_6H_6	K Myristate	C_6H_6
0.0 (=H_2O)	0.185	0.0 (=H_2O)	0.186
0.545	0.187	0.50	0.275
0.769	0.217	1.01	0.42
2.02	0.472	2.01	0.70
3.34	0.760	3.05	1.05
5.08	1.170	4.02	1.36
6.89	1.64	5.03	1.75
9.65	2.50	7.27	2.7
11.93	3.27	10.05	4.04
15.0	4.38	15.03	6.70
16.64	5.01		
19.95	6.41		

Similar results are also given the solubility of Ethyl Benzene and n Heptane in Aqueous Solutions of K Laurate and K Myristate, and for n and iso Propyl Benzene and for n Decanol in K Myristate. Results for the effect of added salts (soap + salt solutions) upon these solubilities are given. The solubilities of 2-Nitro Diphenyl Amine and of 2, 4 Dinitro Diphenyl Amine in aqueous K Laurate Solutions with and without added salts are shown in the form of diagrams.

Results in the form of diagrams are given by Harkins, Mittleman, and Corrin, 1949, for the solubility of Benzene, Ethyl Benzene, n and iso Propyl Benzene, each separately, in aqueous solutions of Potassium Tetra Decanoate and Potassium Do Decanoate. The authors also give results showing the effect of Benzene on the critical micelle concentration of Sodium Decyl Sulfonate and of Potassium Dodecanoate, and for the effect of Alcohols on the critical micelle concentration of Decyl Tetra Methyl Ammonium Bromide.

SOLUBILITY OF BENZENE IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES

(Booth and Everson, 1949)

Gms. Na Sulfonate per 100 gms. Aq. Solvent	cc C_6H_6 per 100 cc Aqueous Solvent in:							
	Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0.0	0.11	0.19	0.11	0.19	0.11	0.19	0.11	0.19
5.0	< 0.05	0.10	0.12	0.34	0.10	0.11	0.11	0.21
10.0	< 0.05	0.10	0.12	0.56	0.10	0.13	0.11	0.21
20.0	< 0.05	0.11	0.21	0.89	0.12	0.32	0.11	0.27
32.0	< 0.05	0.15	--	--	--	--	--	--
34.6	--	--	0.43	1.88	--	--	--	--
40.0	--	--	--	--	0.22	0.44	0.37	1.01

RECIPROCAL SOLUBILITY OF BENZENE AND PERFLUORO-METHYL CYCLOHEXANE ($C_6H_{11}CF_3$)

(Hildebrand and Cochran, 1949)

The sealed tube method was used and the consolute temperature observed during slow cooling of the mixture.

t°	Vol. Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of C_6H_6	t°	Vol. Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of C_6H_6
61.1	0.900	0.950	84.9	0.500	0.687
76.1	0.833	0.916	82.7	0.400	0.593
81.0	0.769	0.876	79.2	0.333	0.523
83.9	0.714	0.845	75.7	0.286	0.467
84.7	0.667	0.814	69.3	0.231	0.397
85.1	0.625	0.785	58.9	0.167	0.305
85.3	0.600	0.767	35.0	0.091	0.190

*Measured at 25°

SOLUBILITY OF BENZENE IN COMPRESSED NITROGEN

(Krichevsky and Gamburg, 1942)

t°	Mol. Fraction of $C_6H_6 \times 10^3$ in the Saturated Solution at Pressures of:						
	50 Atms.	100 Atms.	200 Atms.	400 Atms.	600 Atms.	800 Atms.	1000 Atms.
16	4.03	3.42	4.27	7.62	11.8	15.0	15.5
30	5.39	5.39	6.18	10.4	15.6	19.0	21.3
35	7.90	6.80	7.24	11.9	18.0	22.2	24.9
50	13.0	10.3	10.7	16.6	24.2	32.5	36.5
75	28.5	20.9	18.9	27.8	39.0	51.7	64.5
100	56.3	39.5	31.6	45.4	62.9	80.3	106.0
125	95.5	63.1	52.5	65.4	87.1	120.0	160.0

The vapor-liquid equilibrium pressures and compositions of Benzene-Methyl Alcohol mixtures at 25° to 50° are given by Scatchard, Wood, and Mochel, 1946.

THE CRITICAL SOLUTION TEMPERATURE OF MIXTURES OF BENZENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.s.t. of the Mixture	Solvent	C.s.t. of the Mixture
Water	> 300	Resorcinol	109
Ethylene Glycol	180	Propylene Glycol	90
Triethanol Amine	> 155	m Phenylene Diamine	69
Acetamide	142.5	Lactic Acid	66
Ethanol Amine	103	Triethylene Glycol	22
Diethylene Glycol	92	Ethylene Diformate	< - 5
Monoacetin	93	Ammonia	< -21

The volume change on mixing Benzene and Cyclohexane at constant pressure and from 15° to 75°, is given by Wood and Austin, 1945.

Freezing-point data for mixtures of Benzene with Ethyl Benzene, with o Xylene and with p Xylene are given by Kravchenko, 1949.

PHENOL C_6H_5OH

The temperatures of clouding of known mixtures of Phenol, Cresol and Water, and of Cresol, Xylols and Water were determined and the curves drawn from these data used as the basis of a method for the analysis of mixtures of Phenols. (Faris and Vial, 1948).

SOLUBILITY OF PHENOL IN LIQUID PETROLATUM AT 25°
(Staklosa, 1948)

Solvent	Gms. C_6H_5CH per 100 gms. Saturated Solution
Liquid Petrolatum	1.49
Light Liquid Petrolatum	1.34

The distribution coefficient of Phenol between Ethyl Ether and Water, for concentrations of 580 millimols per liter in the ether layer divided by 13.5 millimols per liter in the water layer is 44 at 19°. (Collander, 1949).

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, p. 389, bottom of page, Change The critical solution temperature to The demixing temperature. The temperature 7° should be -7°.

Freezing-points are given for the following mixtures:

Phenol + Cyclohexanol + Cyclohexanone (Hudlicky, 1949)
" + Ketocineole (2-oxo-cineole) (Bambilla, 1942)
" + Glucose β Pentaacetate (Marsden, Bambridge, and Morris, 1943)
" + Cellobiose α Octacetate " " "
" + Acetanilide (Chichokin and Muskina, 1938)
" + Acetanilide + Aniline (Chichokin and Muskina, 1938)
" + Allylthio Urea " "
" + " " + Aniline " "
" + Naphthalene " "
" + " + Aniline " "

NICOTINIC ACIDAMIDE $C_5H_4NCONH_2$

Freezing-point data for mixtures of Nicotinic Acid Amide and each of the following compounds: Suberic Acid, Azelaic Acid, Dekamethylene Dicarboxylic Acid, Diallyl Barbituric Acid and Pyrocatechol are given by Kofler and Kofler, 1943.

RESORCINOL m $C_6H_4(OH)_2$

The distribution coefficient of Resorcinol between Ethyl Ether and Water (conc. in H_2O : conc. in Ether) is 4.2. (Collander, 1949, quoted from I. C. T.

Freezing-point data are given for mixtures of:

Resorcinol + Naphthalene (Kofler, 1948)
Resorcinol + Ketocineole (2-oxo-cineole) (Brambilla, 1942)

PYROCATECHOL o $C_6H_4(OH)_2$

The distribution coefficient of Pyrocatechol between Ethyl Ether and Water, for concentrations of 881 millimols per liter in the ether layer divided by 81.1 millimols per liter in the water layer, is 11 at 20°. (Collander, 1949).

Freezing-points of mixtures of Pyrocatechol and Monobenzylidene Acetone and of Pyrocatechol and Dibenzylidene Acetone are given by Celincev, 1937.

HYDROQUINONE p $C_6H_4(OH)_2$

Freezing-point data for mixtures of Hydroquinone and Naphthalene are given by Kofler, 1948.

Freezing-points of mixtures of Hydroquinone and Monobenzylidene Acetone and of Hydroquinone and Dibenzylidene Acetone are given by Celincev, 1937.

3 - METHYL, 2 - THIOPHENE CARBOXYLIC ACID $CH_3C_4H_2S \cdot COOH$

Freezing-point data are given by Mislow, 1948 for:

3, Methyl, 2-Thiophene Carboxylic Acid + Benzoic Acid
5, " " " " + " " +
5-Bromo, 2-Thiophene Carboxylic Acid

BENZENE SULFONIC ACID $C_6H_5SO_3H$

The distribution coefficient of Benzene Sulfonic Acid between Ethyl Ether and Water, for concentrations of 0.16 to 1.59 millimols per liter of the ether layer divided by 199 to 1270 millimols per liter of the water layer is 0.0008 to 0.0013 at room temperature. (Collander, 1949).

PYROGALLOL 1, 2, 3 $C_6H_3(OH)_3$

The distribution coefficient of Pyrogallol between Ethyl Ether and Water, for concentrations of 659 millimols per liter in the ether layer divided by 380 millimols per liter in the water layer is 1.7 at 20°. (Collander, 1949).

PHLOROGLUCINOL 1, 3, 5 $C_6H_3(OH)_3$

The distribution coefficient of Phloroglucinol between Ethyl Ether and Water, for concentrations of 84.6 millimols per liter of the ether layer divided by 188 millimols per liter of the water layer is 0.45 at 21°. (Collander, 1949).

ACONITIC ACID 1, 2, 3 - $C_3H_3(COOH)_3$

The distribution coefficient of Aconitic Acid between Ethyl Ether and Water, for concentrations of 24.3 to 236 millimols per liter of the ether layer divided by 72.9 to 498 millimols per liter of the water layer is 0.33 - 0.47 at about 20°. (Collander, 1949).

ANILINE $C_6H_5NH_2$

Results for the liquid-vapor equilibrium of the binary system Aniline-Water are given by Griswold, Andres, Arnett, and Garland, 1940. Methods for the analysis of Aniline-Water solutions are described by Griswold, 1940.

SOLUBILITY OF ANILINE IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES

(Booth and Everson, 1949)

Gms. Na Sulfonate per 100 gms. Aq. Solvent	cc $C_6H_5NH_2$ per 100 cc Aqueous Solvent in:							
	Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0.0	3.80	4.90	3.80	4.90	3.80	4.90	3.80	4.90
5.0	3.88	5.00	5.50	6.71	4.05	5.40	4.30	5.86
10.0	4.29	5.30	11.9	13.4	5.25	6.28	7.10	8.84
20.0	6.92	8.82	42.0	46.0	23.2	22.9	28.3	31.2
25.0	--	--	--	--	--	--	53.8	58.9
30.0	--	--	--	--	118.8	116.9	>400.0	>400.0
32.0	34.0	29.6	--	--	--	--	--	--
34.6	--	--	208.8	267.9	--	--	--	--
40.0	--	--	--	--	400.	400.	>400.0	>400.0

Vapor-Liquid Composition Data are given by Green and Spinks, 1945, for the systems:

Aniline + Ethyl Aniline
" + Diethyl Aniline
Ethyl Aniline + Diethyl Aniline

Freezing-point data are given for the mixtures:

Aniline + Naphthalene (Chichokin and Muskina, 1938)
" + " + Phenol " "
" + Phenol + Allylthio Urea " "
" + " + Acetamide " "
" + Dibromo Benzene " "
" + " " + Phenol " "
" + n Octyl Alcohol (Tschamler, Richter, and Wettig, 1949)

PICOLINE OXALATES, α, β and γ, $CH_3C_5H_4N \cdot (COOH)_2$

SOLUBILITY OF EACH SEPARATELY IN ALCOHOL AND IN ACETONE AT 18-20°

(Grigorowsky, and Kimen, 1945)

Compound	Formula	Gms. Compound per 100 gms. Solvent in:		
		Abs. C_2H_5OH	96% C_2H_5OH	$(CH_3)_2CO$
α Picoline Oxalate	$2C_6H_7N \cdot 3(COOH)_2$	5.39	10.66	1.05
β " "	"	2.23	5.27	0.80
γ " "	$4C_6H_7N \cdot 5(COOH)_2$	1.2	2.34	0.305

PICOLINE PHTHALATES, α , β and γ, $CH_3C_5H_4N \cdot C_6H_4(COOH)_2$

SOLUBILITY OF EACH SEPARATELY IN ALCOHOL AND IN ACETONE AT 18-20°
(Grigorowsky and Kimen, 1945)

Compound	Formula	Gms. Compound per 100 gms. Solvent in: Abs. C_2H_5OH	96% C_2H_5OH	$(CH_3)_2CO$
α Picoline Phthalate	$2C_6H_7N \cdot 3C_6H_4$	10.61	15.2	5.16
β " "	$"(COOH)_2$	39.5	93.9	22.18
γ " "	$C_6H_7N \cdot C_6H_4(COOH)_2$	9.10	12.87	6.51

PHENYLENE DIAMINES o, m and p $C_6H_4(NH_2)_2$

Freezing-point data are given by Pusin and Dezelic, 1939, for the following mixture of Phenylene Diamine with other compounds

o Phenylene Diamine	m Phenylene Diamine	p Phenylene Diamine
+ Benzoic Acid	+ Benzoic Acid	+ Cinnamic Acid
+ Cinnamic Acid	+ Cinnamic Acid	+ Salol
+ Salol	+ Salol	+ Menthol
+ Thymol		+ o Phenylene Diamine

p AMINO BENZAMIDE p $H_2NC_6H_4CONH_2$

Freezing-point data for mixtures of p Amino Benzamide and p Amino Sulfanilamide are given by Kuhn, Möller, Wendt, and Beinert, 1942.

SULFANILAMIDE and Derivatives

Name	Formula
Sulfanilamide (p Amino Benzene Sulfanilamide)	$H_2NC_6H_4SO_2NH_2$
N^1 Acetyl Sulfanilamide	$H_2NC_6H_4SO_2NHCOCH_3$
N^4 Acetyl Sulfanilamide	$CH_3COHNC_6H_4SO_2NH_2$
Sulfaguanidine (N^1 Guanyl Sulfanilamide)	$H_2NC_6H_4SO_2NHCNHNH_2$
N^4 Acetyl Sulfagnanidine	$CH_3COHNC_6H_4SO_2NHCNHNH_2$
Sulfapyridine (N^1-2-Pyridyl Sulfanilamide)	$H_2NC_6H_4SO_2NHC_5H_4N$
N^4 Acetyl Sulfapyridine	$CH_3COHNC_6H_4SO_2NHC_5H_4N$
Sulfathiazole (N^1 Thiazole Sulfanilamide)	$H_2NC_6H_4SO_2NHC_3H_2NS$
N^4 Acetyl Sulfathiazole	$CH_3COHNC_6H_4SO_2NHC_3H_2NS$
Sulfamethyl Thiazole	$H_2NC_6H_4SO_2NHC_3H(CH_3)NS$
N^4 Acetyl Sulfamethyl Thiazole	$CH_3COHNC_6H_4SO_2NHC_3H(CH_3)NS$
Sulfadiazine (N^1 2-Pyrimidyl Sulfanilamide)	$H_2NC_6H_4SO_2NHC_4H_3N_2$
Sulfamerazine (Sulfamethyl Diazine) (N^1-4-Methyl-2 Pyrimidyl Sulfanilamide)	$H_2NC_6H_4SO_2NHC_4H_2(CH_3)N_2$
N^4 Acetyl Sulfamerazine	$CH_3COHNC_6H_4SO_2NHC_4H_2(CH_3)N_2$
Elkosine (2,4 Dimethyl 6-Pyrimidyl Sulfanilamide)	$H_2NC_6H_4SO_2NHC_4H(CH_3)_2N_2$
Metanilamide (m Amino Benzene Sulfonamide)	$H_2NC_6H_4SO_2NH_2$
Orthanilamide (o Amino Benzene Sulfonamide)	$H_2NC_6H_4SO_2NH_2$

SOLUBILITY OF SULFANILAMIDES AND THEIR ACETYL DERIVATIVES IN WATER

(Saposhnikowa and Postowsky, 1944)

Sulfanilamide	Gms. Sulfanilamide per 100 gms. Saturated Solution at:				
	20°	37°	50°	75°	99°
Sulfanilamide	0.53	1.42	2.63	7.58	19.2
N^4 Acetyl Sulfanilamide	0.133	0.289	0.529	1.50	3.55
N' " "	0.627	1.16	--	--	--
Sulfaguanidine	0.769	0.196	0.430	1.40	3.70
N^4 Acetyl Sulfaguanidine	0.0154	0.039	0.100	0.320	0.868
Sulfapyridine	0.0194	0.047	0.094	0.24	0.61
N^4 Acetyl Sulfapyridine	0.0056	0.015	0.026	0.067	0.20
Sulfamethyl Thiazole	0.0088	0.0220	0.0423	0.0130	0.390
N^4 Acetyl Sulfamethyl Thiazole	0.0022	0.0055	0.008	0.035	0.086
Sulfathiazole	0.037	0.088	0.168	0.530	1.20
N^4 Acetyl Sulfathiazole	--	0.0071	0.013	0.047	0.126
Sulfamethyl Diazine	--	0.0255	0.05	0.172	0.319
N^4 Acetyl Sulfamethyl Diazine	--	0.024	--	0.170	--

SOLUBILITY OF ORTHANILAMIDE, METANILAMIDE AND SULFANILAMIDE, EACH SEPARATELY, IN WATER

(Kienle and Sayward, 1942)

	Gms. Amide per 100 gms. Sat. Sol.		
	Orthanilamide	Metanilamide	Sulfanilamide
23	0.65	1.14	0.64
26	0.75	1.34	0.77
28	0.82	1.48	0.87
30.5	0.91	--	1.01
35.5	1.11	2.19	1.37
37.0	1.20	2.36	1.47
42.0	1.46	3.01	1.84
46.0	1.70	3.70	2.21
50.0	2.00	4.58	2.68

SOLUBILITY IN AQUEOUS BUFFERED SOLUTIONS OF VARIOUS pH VALUES AT 37°

pH	Ionic Strength	Gms. Amide per 100 gms. Sat. Sol.		
		Orthanilamide	Metanilamide	Sulfanilamide
1.2	0.12	1.92	4.48	4.07
2.2	0.05	1.31	3.07	1.79
4.2	0.84	1.05	2.26	1.40
6.9	0.03	1.19	2.30	1.44
(5.7)	H_2O	1.19	2.36	1.47
9.4	0.08	1.34	2.61	1.55
9.7	0.09	1.39	2.60	1.60
12.4	0.23	1.96	3.28	2.05

SOLUBILITY OF SULFADIAZINE IN AQUEOUS BUFFERED SOLUTIONS OF VARIOUS pH VALUES AT 25°

(Erebs and Speakman, 1945)

pH	Gms. Amide per 100 cc Sat. Sol.	pH	Gms. Amide per 100 cc Sat. Sol.	pH	Gms. Amide per 100 cc Sat. Sol.
1.0	0.068	2.69	0.0075	6.82	0.0194
1.26	0.066	3.06	0.0069	7.23	0.0435
1.55	0.0252	4.89	0.0063	7.56	0.086
1.89	0.0165	6.01	0.0085	7.67	0.114
2.31	0.0093	6.35	0.0111		

SOLUBILITY OF SULFANILAMIDE DERIVATIVES IN FRESH URINE AT 25°

(Sjogren and Örtenblad, 1947)

Sulfanilamide Derivative	Gms. Amide per 100 cc Sat. Sol. at pH: 5.5	6.0	6.5	7.0	7.5	7.9
Sulfathiazole	0.103	0.105	0.111	0.151	0.263	0.450
Acetyl "	0.0071	0.0088	0.0115	0.017	0.028	0.069
Sulfadiazine	0.010	0.017	0.028	0.048	0.104	0.200
Acetyl "	0.010	0 038	0.134	0.205	0.564	0.850
Sulfamerazine	0.037	0.038	0.044	0.068	0.127	0.310
Acetyl "	0.079	0.080	0.1[illegible]	0.202	0.388	0.650
Elkosine	0.222	0.238	0.2[illegible]	0.300	0.435	0.620
Acetyl "	0.0073	0.007[illegible]	0.00[illegible]	0.0110	0.0175	0.029

Results are also given for the solubility of m[illegible]tures of the above compounds which show that each one dissolves ind[illegible]pendently of the other.

SOLUBILITY OF SULFANILAMIDE AND OF SULFAPYRIDINE, EACH SEPARATELY, IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL

(Saposhnikowa and Postowsky, 1944)

Wt. % Aq. C_2H_5OH	Gms. per 100 gms. Saturated Solution: Sulfanilamide At 37°	Sulfapyridine At 37°	Sulfapyridine At 75°
0.0 (H_2O)	1.42	0.047	0.25
19.2	--	0.32	0.91
38.3	2.4	0.37	1.57
57.6	3.8	0.58	3.00
67.2	4.9	--	3.10
76.4	7.0	0.54	3.00
86.0	4.8	--	--
96.0	3.9	0.39	2.3

SOLUBILITY OF N' N^4 DIACETYL SULFANILAMIDE, SULFAGUANIDINE AND N^4 ACETYL SULFAGUANIDINE, EACH SEPARATELY, IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AT 75°

(Saposhnikowa and Postowsky, 1944)

Wt. % Aqueous C_2H_5OH	Gms. per 100 gms. Saturated Solution		
	N' N^4 Diacetyl Sulfanilamide	Sulfaguanidine	N^4 Acetyl Sulfaguanidine
0.0 (H_2O)	0.24	1.40	0.32
19.2	0.71	2.67	0.77
38.3	1.59	--	1.31
57.6	2.3	4.43	3.24
67.2	3.6	--	--
76.4	3.7	5.56	3.78
86.0	--	4.80	--
96.0	4.3	3.53	2.50

SOLUBILITY OF SULFAPYRIDINE, SULFATHIAZOLE AND 1-METHOXY-2-AMINO-4-NITRO BENZENE, EACH SEPARATELY, IN AQUEOUS SOLUTIONS OF CAFFEINE

(Neish, 1948)

The solutions were shaken frequently at 37° for 5 hours and then allowed to stand at room temperature for 1 hour before filtering. The Amine content of the clear solution was determined by a colorimetric diazotization procedure.

Gms. Caffeine per 100cc Aq. Solvent	Milligrams per liter of Solution Saturated with:		
	Sulfapyridine	Sulfathiazole	1-Methoxy, 2-Amino 4-Nitro Benzene
0.0 (H_2O)	0.370	0.490	0.570
0.5	0.470	0.500	0.940
0.75	0.480	0.530	--
1.00	--	0.650	1.560

SOLUBILITY OF SULFONAMIDES IN METHYL CYCLOHEXANONE AT 25°

(Barber and Wilkerson, 1946)

Compound	Gms. Compound per 100 cc Sat. Sol.
Sulfanilamide	4.7
Sulfathiazole	8.5
Sulfapyridine	3.5

ASCORBIC ACID (1) $C_6H_8O_6$

SOLUBILITY OF ASCORBIC ACID IN WATER AND IN 96% ETHYL ALCOHOL

(Slobodin, Basova, and Helms, 1946)

t°	Gms. $C_6H_8O_6$ per 100 gms.		t°	Gms. $C_6H_8O_6$ per 100 gms.	
	H_2O	96% C_2H_5OH		H_2O	96% C_2H_5OH
0	13.59	3.33	40	32.75	6.62
5	15.57	--	45	35.46	--
10	17.79	--	50	38.24	8.27
15	19.85	--	55	40.64	--
20	22.42	4.61	60	42.34	10.65
25	24.48	--	70	46.57	--
30	27.16	5.59	78	--	17.76
35	29.97	--	80	50.47	--
			100	57.51	--

TRICARBALLYLIC ACID $HOOCCH_2CH(COOH)CH_2COOH$

The distribution coefficient of Tricarballylic Acid between Ethyl Ether and Water, for concentrations of 5.3 millimols per liter in the ether layer divided by 83.5 millimols per liter in the water layer is 0.060 at 19°. (Collander, 1949).

CITRIC ACID $CH_2C(OH)CH_2(COOH)_3$

DISTRIBUTION OF CITRIC ACID BETWEEN WATER AND ORGANIC SOLVENTS

(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration of the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.16%) divided by the conc. in the organic solvent layer.

Solvents in Contact with H_2O layer	Dist. Coef. K $\frac{\text{conc. } H_2O \text{ layer}}{\text{conc. org. layer}}$	Solvents in Contact with H_2O layer	Dist. Coef. K $\frac{\text{conc. } H_2O \text{ layer}}{\text{Conc. org. layer}}$
n Butanol	3.5	Diisopropyl Ketone	10 +
Ethyl Acetate	10 +	Butyl Acetate	10 +
Ethyl Ether	10 +	Methyl Isobutyl Ketone	10 +
Chloroform	10 +	Methyl Propyl Ketone	6.2
Skellysalve B	10 +	Methyl Ethyl Ketone	3.0
Carbon Tetrachloride	10 +	Cyclohexanone	4.7
Benzene	10 +		

The distribution coefficient of Citric Acid between Ethyl Ether and Water, for concentrations of 0.73 - 7.55 millimols per liter of the ether layer divided by 92.6 - 880 millimols per liter of the water layer is 0.0079 - 0.0086 at 19°. (Collander, 1949).

SOLUBILITY OF CITRIC ACID IN FURFURAL

(Trimble, 1941)

t°	Gms. $CH_2C(OH)CH_2(COOH)_3$ per 100 gms. Sat. Sol.
0	0.3
25	3.6
40	9.9

HISTIDINE PHOSPHOTUNGSTATE $2C_6H_9O_2N_3 \cdot 3HPO_4 \cdot 2WO_3 \cdot 12H_2O$

SOLUBILITY OF HISTIDINE PHOSPHOTUNGSTATE IN AQUEOUS SOLUTION AT 22°

(Van Slyke, Hiller, and Dillon, 1942)

The determinations were made both by precipitation and by resolution of the Phosphotungstate in the aqueous solvent. Varying ratios of excess of Phosphotungstic Acid (PTA) and Histidine and also of concentrations of HCl were used.

Original Solvent		Additional Millimols per liter		Solubility of $C_6H_9O_2$ in Millimols per liter	
Normality HCl	Gms. PTA per liter	$C_6H_9O_2$	PTA	Precipitation Method	Resolution Method
1.0	50.0	2.1	18.3	0.55	--
1.0	50.0	16.80	29.6	0.57	--
0.0	50.0	---	--	--	0.299
0.25	50.0	---	--	--	0.390
0.50	50.0	---	--	--	0.470
1.00	50.0	---	--	--	0.547
2.00	50.0	---	---	--	0.347
3.00	50.0	---	--	--	0.233

Results for the effect of temperature on the solubility of Histidine Phosphotungstate in Aqueous 0.25 n HCl, determined by the resolution method, are given in the form of a diagram from which the following values of Histidine PTA, expressed as milligrams of amino-acid Nitrogen per liter, were taken.

t°	Mgs. Amino-acid N per liter	t°	Mgs. Amino-acid N per liter
0	4.5	25	11.0
10	6.0	30	20.0
20	9.5	40	48.0

HEXADIENE 1, 5- $CH_2:CHCH_2CH_2CH:CH_2$

THE SOLUBILITY OF WATER IN HEXADIENE AT 1.0 ATMOSPHERE PRESSURE

(Black, Joris, and Taylor, 1948)

The determinations were made with the use of Tritium Oxide as a tracer.

t° of Saturation	Solubility in: Mols. H_2O per 100 mols. C_6H_{10}	Gms. H_2O per 100 gms. C_6H_{10}
13.5	0.2820	0.0618
20.2	0.4417	0.0969

ADIPIC ACID $COOH(CH_2)_4COOH$

SOLUBILITY OF ADIPIC ACID IN WATER
(Attane and Doumani, 1949)

t°	Gms. $COOH(CH_2)_4COOH$ per 100 gms. H_2O	t°	Gms. $COOH(CH_2)_4COOH$ per 100 gms. H_2O
15	1.44	60	17.6
34.1	3.08	70	34.1
40	5.12	87.1	94.8
50	9.24	100	100.0

DISTRIBUTION OF ADIPIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration of the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.16%) divided by the conc. in the organic solvent layer.

Solvents, Water +	Dist. Coef.K	Solvents, Water +	Dist. Coef.K
Chloroform	10 +	Methyl Isobutyl Ketone	1.2
Carbon Tetrachloride	10 +	Ethyl Acetate	0.91
Benzene	10 +	Methyl Propyl Ketone	0.55
Skellysolve B	10 +	Methyl Ethyl Ketone	0.50
Diiso Propyl Ketone	4.8	n Butanol	0.33
Butyl Acetate	2.9	Cyclohexanone	0.32
Ethyl Ether	2.2		

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Adipic Acid between Ethyl Ether and Water, for concentrations of 27 - 138 millimols per liter of the ether layer is 0.51 - 0.54 at 25°. (Collander, 1949, qouted from Derner, Markham, and Trimble, 1941).

Freezing-point data for mixtures of Adipic Acid with Pimelic Acid and with Suberic Acid are given by Houston and Van Sandt, 1946.

ETHYLENE ACETATE (Glycol Diacetate) $(CH_2OOCCH_3)_2$

The distribution coefficient of Ethylene Acetate between Ethyl Ether and Water, for concentrations of 626 millimols per liter in the ether layer divided by 309 millimols per liter in the water layer is 2.0 at 20°. (Collander, 1949).

DILACTIC ACID $(CH_3CHCOOH)_2O$

Freezing-point data for mixtures of the optical active forms of Dilactic Acid, Thio-Dilactic Acid, Dimethyl Glutaric Acid, Dimercapto Adipic Acid, Ethyl Carbothiolactic Acid and Ethyl Dithio Carbamino Propionic Acid are given by Fredga, 1940, 1942.

CYCLOHEXANE C_6H_{12}

100 gms. Cyclohexane dissolve 0.01 gm. H_2O at 20° (Black, Jöris, and Taylor, 1948).

THE CRITICAL SOLUTION TEMPERATURE OF MIXTURES OF CYCLOHEXANE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetanilide	103	Ethyl Furoate	-1
Acetic Acid	6	Ethyl Lactate	-2
Acetic Anhydride	52	Ethyl Oxalate	5
Acetone	-29	Ethylene Diacetate	18
Acetonitrile	76	Ethylene Dichlorhydrin	81
Acetophenone	-16	Eugenol	-38
Aldol	-2	Fuoric Acid	98
p Amino Diphenyl	63	Furfural	69
Ammonia	59	Furfuryl Alcohol	78
Amyl Fuorate	-50	Methanol	45
Aniline	31	Methyl Anthranilate	16
Anthranilic Acid	118	Methyl Carbitol	63
Benzaldehyde	-22	Methyl Cellosolve	25
Benzoic Anhydride	11	Methyl Furoate	34
Benzyl Alcohol	2	Methyl Sulfate	100
o Benzyl Phenol	0	α Naphthonitrile	25
Butyl Furoate	-44	β Naphthonitrile	30
n Butyramide	131	α Naphthyl Amine	57
Carbitol	< -1	β Naphthyl Amine	65
Carbon Dioxide	-37	3,4 Nitro Amino Toluene	107
Catechol	120	o Nitro Aniline	133
Cellosolve	-60	p Nitro Benzyl Chloride	56
Chloro Acetic Acid	86	Nitro Benzene	-4
o Chloro Aniline	-25	o Nitro Chloro Benzene	0
o Chloro Phenol	-44	Nitro Methane	79
p Chloro Phenol	13	o Nitro Phenol	25
Chlorex	-11	o Nitro Toluene	-28
Cinnamyl Alcohol	39	o Phenetidine	-2
o Cresol	-36	p Phenetidine	46
m Cresol	-53	Phenyl Hydrazine	61
p Cresol	-51	Phenyl Phthalate	41
Cresylic Acid	-51	Phthalic Anhydride	128
Croton Aldehyde	-31	n Propyl Furoate	-48
Diacetone Alcohol	-6	Pyridine	-36
Dicroton	-36	Salicyl Aldehyde	5
m Dinitro Benzene	143	Sulfur Dioxide	13
Dinitro Chloro Benzene	124	Tetrahydro Furfuryl Alcohol	39
Diphenyl Ethylene Diamine	33	o Toluidine	-7
Ethyl Aceto Acetate	24	Xylidines	-49
Ethyl Formate	-48		

HEXAMETHYLENE TETRAMINE $(CH_2)_6N_4$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Hexamethylene Tetramine between Ethyl Ether and Water, for a concentration of about 250 millimols per liter in the water layer is 0.0026 at about 20°. (Collander, 1949, quoted from Collander and Bärlund, 1933).

CYCLOHEXANOL $C_6H_{11}OH$

SOLUBILITY OF CYCLOHEXANOL IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES

(Booth and Everson, 1949)

Gms. Sulfonate per 100 cc Aqueous Solvent	cc $C_6H_{11}OH$ per 100 cc Aqueous Solvent in:							
	Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0	3.40	3.38	3.40	3.38	3.40	3.38	3.40	3.38
5	4.08	3.71	13.6	11.0	4.42	4.13	4.0	5.03
8	--	--	31.1	25.9	--	--	--	--
10	4.43	4.05	--	--	8.68	8.62	17.3	20.2
15	--	--	54.2	61.6	54.1	61.8	131.0	127.0
20	14.1	13.8	76.7	70.6	>400.0	365.0	>400.0	>400.0
22	28.8	27.0	--	--	--	--	--	--
25	>400.0	>400.0	--	--	--	--	--	--
32	>400.	>400.	--	--	--	--	--	--
34.6	--	--	145.0	119.4	--	--	--	--
40	--	--	--	--	>400.0	>400.0	>400.0	>400.0

3-METHYL PENTANONE-2 $CH_3COCH(CH_3)CH_2CH_3$

RECIPROCAL SOLUBILITY OF 3-METHYL PENTANONE-2 AND WATER

(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_6H_{12}O$ per 100 gms.	
	H_2O rich Phase	$C_6H_{12}O$ rich Phase
20	2.26 (0.9926)	98.05 (0.8328)
25	2.09 (0.9944)	97.97 (0.8131)
30	1.93 (0.9935)	97.83 (0.8088)

The figures in parenthises are the densities at the respective temperatures.

4-METHYL PENTANONE-2 $CH_3COCH_2CH(CH_3)_2$

RECIPROCAL SOLUBILITY OF 4-METHYL PENTANONE-2 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_6H_{12}O$ per 100 gms.	
	H_6O rich Phase	$C_6H_{12}O$ rich Phase
20	2.04 (0.9951)	97.59 (0.8092)
25	1.91 (0.9944)	97.93 (0.8018)
30	1.78 (0.9932)	97.80 (0.7981)

The figures in parenthises are the densities.

4-METHYL PENTANONE-3 $(CH_3)_2CHCOC_2H_5$

RECIPROCAL SOLUBILITY OF 4-METHYL PENTANONE-3 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_6H_{12}O$ per 100 gms.	
	H_2O rich Phase	$C_6H_{12}O$ rich Phase
20	1.63 (0.9959)	98.79 (0.8128)
25	1.52 (0.9952)	98.69 (0.8088)
30	1.42 (0.9941)	98.60 (0.8047)

The figures in parenthises are the densities.

3, 3-DIMETHYL BUTANONE-2 (Pinacolin) $CH_3COC(CH_3)_3$

RECIPROCAL SOLUBILITY OF 3, 3-DIMETHYL BUTANONE-2 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_6H_{12}O$ per 100 gms.	
	H_2O rich Phase	$C_6H_{12}O$ rich Phase
20	2.04 (0.9954)	98.35 (0.8097)
25	1.90 (0.9946)	98.24 (0.8053)
30	1.77 (0.9933)	98.14 (0.8010)

HEXANONE

HEXANONE-3 $C_2H_5CO(CH_2)_2CH_3$

RECIPROCAL SOLUBILITY OF HEXANONE-3 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_6H_{12}O$ per 100 gms.	
	H_2O rich Phase	$C_6H_{12}O$ rich Phase
20	1.57 (0.9962)	98.47 (0.8175)
25	1.47 (0.9952)	98.38 (0.8134)
30	1.38 (0.9943)	98.30 (0.8087)

The figures in parenthises are the densities.

HEXANONE-2 $CH_3CO(CH_2)_3CH_3$

RECIPROCAL SOLUBILITY OF HEXANONE-2 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_6H_{12}O$ per 100 gms.	
	H_2O rich Phase	$C_6H_{12}O$ rich Phase
20	1.75 (0.9959)	97.88 (0.8154)
25	1.64 (0.9950)	97.75 (0.8117)
30	1.53 (0.9938)	97.64 (0.8079)

The figures in parenthises are the densities.

CAPROIC ACID $CH_3(CH_2)_4COOH$

SOLUBILITY OF CAPROIC ACID IN WATER
(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_4COOH$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_4COOH$ per 100 gms. H_2O
0	0.864	30	1.019
15	0.882*	45	1.095
20	0.968	60	1.171

*Quoted from Lewkowitch.

The distribution coefficient of Caproic Acid between Ethyl Ether and Water, for concentrations of 133 to 1254 millimols per liter of the ether layer divided by 1.66 to 13.5 millimols per liter of the water layer is 80 - 93 at about 20°. (Collander, 1949).

The eutectic of mixtures of Caproic and Acetic Acids is at -5.4° and 97.7 wt. % $CH_3(CH_2)_4COOH$ (Ralston and Hoerr, 1942).

SARCOSINE ANHYDRIDE $(CH_3NHCH_2CO)_2O$

Freezing-point data for the system Sarcosine Anhydride–Cholesterol are given by Branstatter, 1943.

CYSTINE PHOSPHOTUNGSTATE $[SCH_2CH(NH_2)COOH]_2 \cdot H_3PO_4 \cdot 12WO_3 \cdot 6H_2O$

SOLUBILITY OF CYSTINE PHOSPHOTUNGSTATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 22°
(Van Slyke, Hiller, and Dillon, 1942)

Normality of Aq. HCl Solvent*	Millimols Amino Acid per liter Sat. Sol.
0.0 (H_2O)	0.450
0.25	0.507
0.50	0.596
1.0	0.566
2.0	0.364

*The aqueous solvent contained also 50 gms. Phosphotungstate Acid per liter.

Results for the effect of temperature upon the solubility of Cystine Phosphotungstate in Aqueous 0.25 n HCl are given in the form of a diagram from which the following approximate values, expressed as milligrams of Amino Acid Nitrogen per liter, were taken.

t°	Mgs. Amino Acid N per liter	t°	Mgs. Amino Acid N per liter
0	0.82	25	20.
10	3.5	30	32.
20	11.5	40	80.

RHAMNOSE $C_6H_{12}O_5 \cdot H_2O$

The distribution coefficient of Rhamnose between Ethyl Ether and Water, for a concentration of 1000 millimols per liter in the water layer is 0.00019 at 19°. (Collander, 1949).

SORBOSE $C_6H_{12}O_6$

SOLUBILITY OF SORBOSE IN WATER AND IN ETHYL ALCOHOL
(Slobodin, Basova, and Helms, 1946)

t°	Gms. $C_6H_{12}O_6$ per 100 gms. Sat. Sol.	
	H_2O	C_2H_5OH
0	37.8	--
20	44.0	0.5
40	51.1	0.96
60	57.7	1.85
80	64.4	2.9 (78°)
100	71.8	--

GLUCOSE $C_6H_{12}O_6$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glucose between Ethyl Ether and Water, for a concentration of about 2000 millimols per liter in the water layer, is 0.0000[illegible] at 19°. (Collander, 1945).

GLUCONIC ACID $C_5H_6(OH)_5COOH$

The distribution coefficient of Gluconic Acid (a mixture of lactonized and non-lactonized acid) between Ethyl Ether and Water, for concentrations of 0.5 millimols per liter of the ether layer divided by 2500 millimols per liter of the water layer is 0.0002 at 20°. (Collander, 1949).

LEUCINE (1) $(CH_3)_2CHCH_2CH(NH_2)COOH$

100 gms. H_2O dissolve 2.19 gms. l, Leucine at 25° (Stoddard and Dunn, 1942).

The authors review the results of other determinations in water at temperatures between 0° and 25°.

The distribution coefficient of Leucine between Ethyl Ether and Water, for concentrations of 0.0028 millimols per liter in the ether layer divided by 232 millimols per liter in the water layer is 0000012 at 19°. (Collander, 1949).

100 cc Butyric Acid dissolve 0.024 gms. Leucine at 18°. (Przylecki, and Kasprzyle-Czaykowska, 1938).

LEUCINE (dl) $(CH_3)_2CHCH_2CH(NH_2)COOH$

SOLUBILITY OF dl LEUCINE IN ANHYDROUS LIQUID AMMONIA
(Zachary and Moore, 1949)

t°		Moles $C_6H_{13}O_2$ per liter Sat. Sol.
°K	°C	
196	-77	0.050
210	-63	0.053
277.5	-45.5	0.055
238	-35	0.057

GLUCOSE AMINE $C_6H_{13}O_5N$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glucose Amine between Ethyl Ether and Water, for a concentration of about 100 millimols per liter of the water layer is 0.0001 at 22°. (Collander, 1949).

n HEXANE $CH_3(CH_2)_4CH_3$

100 gms. n Hexane dissolve 0.0111 gms. H_2O at 20°.

100 gm. mols. n Hexane dissolve 0.053 gm. mols. H_2O at 20°.
(Black, Joris, and Taylor, 1948).

The solubility of n Hexane in aqueous solutions containing from 0 to 40 percent of Sodium Benzene Sulfonate, Sodium p Cymene Sulfonate, Sodium Toluene Sulfonate and Sodium Xylene Sulfonate was found to be less than 0.05 gm. per 100 cc aqueous solvent at 25° and 60°. (Booth and Everson, 1949).

The Aniline point of n Hexane is 68.6°. (Ludeman, 1940, quoted from Evans, 1937).

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF n HEXANE AND VARIOUS SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetic Acid	-5	Ethyl Formate	-40
Acetic Anhydride	59	Ethyl Aceto Acetate	32
Chloro Acetic Acid	137	Ethyl Lactate	8
Furoic Acid	166	Ethyl Oxalate	15
Benzoic Anhydride	79	Butyl Oxalate	-58
Phthalic Anhydride	197	Methyl Fuorate	50
Anthranilic Acid	219	Ethyl Fuorate	16
Methanol	35	n Propyl Furoate	-28
Ethanol	<-78	n Butyl Furoate	-26
Diacetone Alcohol	10	n Amyl Furoate	-36
Methyl Cellosolve	28	Methyl Anthranilate	47
Cellosolve	-32	Ammonia	56
Methyl Carbitol	85	Carbon Dioxide	-61
Carbitol	12	Sulfur Dioxide	10.2
Ethylene Chlorohydrin	101	Acetone	-39
Furfuryl Alcohol	115	Acetonyl Acetone	59
Tetrahydro Furfuryl Alcohol	82	Acetophenone	3
Benzyl Alcohol	49	Nitro Benzene	21
Phenyl Ethanol	33	o Nitro Toluene	0
Cinnamyl Alcohol	100	o Nitro Phenol	41
Croton Aldehyde	-21	o Nitro Chloro Benzene	41
Dicroton	-22	p Nitro Benzyl Chloride	104
Aldol	23	2-Nitro-4-Methyl Phenol	18
Paraldehyde	-61	2, 4-Dinitro Chloro Benzene	199
Furfural	92	Phenol	51
Benzaldehyde	3	o Cresol	5
Salicyl Aldehyde	31	m Cresol	12
Aniline	69	p Cresol	11
o Toluidine	25	Cresylic Acid	0
Xylidines	-22	o Chloro Phenol	5
α Naphthyl Amine	117	p Chloro Phenol	69
β Naphthyl Amine	143	2, 4-Xylen-1-ol	-70
o Amino Diphenyl	45	o Benzyl Phenol	65
p Amino Diphenyl	134	Eugenol	0
Diphenyl Amine	23	m Hydroxy Diphenyl	134
Diphenyl Ethylene Diamine	100	β Naphthol	145
Phenyl α Naphthyl Amine	69	n Butyramide	174
o Chloro Aniline	14	Chlorex	11
o Nitro Aniline	233	Dioxane	-13
3, 4 Nitro Amino Toluene	181	α Naphthonitrile	73
o Phenetidine	26	β Naphthonitrile	79
p Phenetidine	81	Pyridine	-25

DIMETHYL BUTANE 2, 2- $(CH_3)_3CCH_2CH_3$ and 2, 3- $(CH_3)_2CHCH(CH_3)_2$

METHYL PENTANE 2- $(CH_3)_3CH(CH_2)_2CH_3$

The critical solution temperature of 2-Methyl Pentane with Aniline is 74.7°. (Ludeman 1940, quoted from Evans, 1937).

The pressure, volume, temperature relations for n Hexane, 2-Methyl Pentane and 2, 3 Methyl Butane are given by Kelso and Felsing, 1942.

Equilibrium in the binary systems 2, 2 Dimethyl Butane - 2, 3 Dimethyl Butane and 2, 2 Dimethyl Butane - Cyclo Pentane, are given by Fink, Cines, Frey, and Aston, 1947.

LYSINE PHOSPHOTUNGSTATE $[NH_2(CH_2)_4CH(NH_2)COOH]_3 \cdot 2H_3PO_4 \cdot 12WO_3 \cdot 10H_2O$

SOLUBILITY OF LYSINE PHOSPHOTUNGSTATE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 22°

(Van Slyke, Hiller, and Dillon, 1942)

Normality of Aqueous HCl Solvent	Millimols Amino Acid per liter Saturated Solution
0.25	0.055
0.50	0.081
1.0	0.084
2.0	0.040

Results for the effect of temperature on the solubility of Lysine Phosphotungstate in Aqueous 0.25 n HCl, determined by the resolution method, are given in the form of a diagram from which the following approximate values, expressed as milligrams of Amino Acid Nitrogen, were taken.

t°	Milligrams Amino Acid N per liter	t°	Milligrams Amino Acid N per liter
0	0.36	25	2.1
10	0.85	30	2.5
20	1.7	40	2.9

ARGININE PHOSPHOTUNGSTATE $[NH_2C(:NH)NH(CH_2)_3CH(NH_2)COOH]_3 \cdot 2H_3PO_4 \cdot 12WO_3 \cdot 8H_2O$

SOLUBILITY OF ARGININE PHOSPHOTUNGSTATE IN AQUEOUS SOLUTIONS AT 22°

(Van Slyke, Hiller, and Dillon, 1942)

The determinations were made both by precipitation and by resolution of the Phosphotungstate in the aqueous solvent. Various ratios of excess of Phosphotungstic Acid (PTA) and Arginine, and also of concentration of HCl were used.

Original Solvent		Additional Millimols per liter		Solubility of Arginine in Millimols per liter	
Normality HCl	Gms. PTA per liter	Arginine	PTA	Precipitation Method	Resolution Method
1.0	50.0	2.36	18.3	0.223	0.217
1.0	50.0	4.73	20.0	0.229	0.217
1.0	50.0	9.46	23.2	0.233	0.217
1.0	50.0	18.92	29.4	0.235	0.213
0.0	50.0	---	--	--	0.066
0.25	50.0	---	--	--	0.069
0.5	50.0	---	--	--	0.150
1.0	50.0	---	--	--	0.217
2.0	50.0	---	--	--	0.221
3.0	50.0	---	--	--	0.100

Results for the effect of temperature on the solubility of Arginine Phosphotungstate in Aqueous 0.25 n HCl, determined by the resolution method are given in the form of a diagram from which the following approximate values, expressed as milligrams of Amino Acid Nitrogen, were taken.

t°	Milligrams Amino Acid N per liter	t°	Milligrams Amino Acid N per liter
0	1.08	25	5.0
10	1.7	30	7.5
20	3.3	40	18.0

DIETHYL GLYCOL meso and dl $CH_3CH_2CHOHCHOHCH_2CH_3$

Freezing-point data for mixtures of meso and dl Diethyl Glycol are given by Young, Cristol, and Weiss, 1943.

HEXAMETHYLENE GLYCOL (1, 6-Hexanediol) $CH_2OH(CH_2)_4CH_2OH$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Hexamethylene Glycol between Ethyl Ether and Water, for a concentration of about 900 millimols per liter of the water layer is 0.12 at 20°. (Collander, 1949).

2, 4-PENTANEDIOL, 2-METHYL $(CH_3)_2COHCH_2CHOHCH_3$

The distribution coefficient of 2, 4-Pentanediol, 2-Methyl between Ethyl Ether and Water, for concentrations of 290 millimols per liter in the ether layer divided by 571 millimols per liter in the water layer is 0.51 at 20°. (Collander, 1949).

PINACOL $(CH_3)_2C(OH)COH(CH_3)_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Pinacol between Ethyl Ether and Water, for a concentration of about 500 millimols per liter in the water layer is 0.43 at 20°. (Collander, 1949, quoted from Bärlund, 1929).

CARBITOL (Diethylene Glycol Monoethyl Ether) $C_2H_5OCH_2CH_2OCH_2CH_2OH$ **and Other Organic Solvents.**

SOLUBILITY OF WATER IN CARBITOL AND OTHER ORGANIC SOLVENTS AT 4.5°
(Copley, Ginsberg, Zellhoeffer, and Marvel, 1941)

Organic Solvent	Mol. Fraction H_2O in Sat. Sol.
Carbitol	0.126
Triethylene Tetramine	0.588
Tetraethylene Pentamine	0.622
Methylated Triethylene Tetramine I ($C_9H_{24}N_4$, Trimethyl)	0.398
Triacetyl, Trimethyl, Triethylene Tetramine ($C_{15}H_{20}O_3N_4$)	0.610
Hexamethylene Diamine	0.382
Dimethylether of Tetramethylene Glycol	0.099
Triethyl Phosphate	0.104

TRIETHYLENE GLYCOL $(CH_2OCH_2CH_2OH)_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Triethylene Glycol between Ethyl Ether and Water, for a concentration of about 1000 millimols per liter in the water layer is 0.0031 at about 20°. (Collander, 1949).

SORBITOL $C_6H_{14}O_6 \cdot \frac{1}{2}H_2O$

SOLUBILITY OF SORBITOL IN WATER AND IN ETHYL ALCOHOL
(Slobodin, Basova, and Helms, 1946)

t°	Gms. $C_6H_{14}O_6$ per 100 gms.	
	H_2O	C_2H_5OH
20	72	2.8
50	--	7.6
60	86.5	---
78	--	20.0
100	98. (approx.)	

TRIETHYL AMINE $(C_2H_5)_3N$

THE SYSTEM TRIETHYL AMINE - WATER
(Roberts and Mayer, 1941)

Results for the consolute curve

t° of Appearance of Turbidity	Gms. $(C_2H_5)_3N$ per 100 gms. Mixture
18.9	15.7
18.4	25.1
18.7	44.8
20.0	73.0
22.2	92.0

Results are also given for the compositions of the liquid and vapor phases at pressures from 1.22 to 5.75 centimeters Hg and temperatures from 0° to 18°.

The distribution coefficient of Triethyl Amine between Ethyl Ether and Water, for concentrations of 97.4 millimols per liter in the ether layer divided by 16.4 millimols per liter in the water layer is 5.9 at 18°. (Collander, 1949).

TRIETHYL AMINE HYDROCHLORIDE $(C_2H_5)_3N \cdot HCl$

SOLUBILITY OF TRIETHYL AMINE HYDROCHLORIDE IN NITRO BENZENE CONTAINING METHYL ALCOHOL AND TRIETHYL AMINE AT 25°
(Bartlett and Nebel, 1940)

Gm. mols. per liter Saturated Solution		
CH_3OH	$(C_2H_5)_3N$	$(C_2H_5)_3N \cdot HCl$
0.0	0.0	0.0157
0.0	0.101	0.0147
0.0833	0.102	0.0236
0.167	0.102	0.0356
0.250	0.102	0.0468

DIPROPYL AMINE $(CH_3CH_2CH_2)_2NH$

The distribution coefficient of Dipropyl Amine between Ethyl Ether and Water, for concentrations of 97.9 millimols per liter of the ether layer divided by 14.3 millimols per liter of the water layer is 6.8 at 17°. (Collander, 1949).

DIETHYL ETHANOL AMINE $C_6H_{15}ON$

The distribution coefficient of Diethyl Ethanol Amine between Ethyl Ether and Water, for concentrations of 82 millimols per liter of the ether layer divided by 233 millimols per liter of the water layer is 6.8 at 17°. (Collander, 1949).

DIISO PROPYL AMINE $[(CH_3)_2CH]_2NH$

The distribution coefficient of Diiso Propyl Amine between Ethyl Ether and Water, for concentrations of 4.46 millimols per liter of the ether layer divided by 750 millimols per liter of the water layer is 0.0059 at 20°. (Collander, 1950).

TRIETHANOL AMINE $N(CH_2CH_2OH)_3$

The distribution coefficient of Triethanol Amine between Ethyl Ether and Water, for concentrations of 0.78 millimols per liter in the ether layer divided by 707 millimols per liter in the water layer is 0.0011 at 20°. (Collander, 1949).

HEXYL AMMONIUM CHLORIDE $C_6H_{13}NH_3Cl$

SOLUBILITY OF HEXYL AMMONIUM CHLORIDE IN AQUEOUS ETHYL ALCOHOL
(Ralston and Hoerr, 1946)

Wt. % C_2H_5OH	Gms. $C_6H_{13}NH_3Cl$ per 100 gms. Solvent at: 0.0°	20.0°	40.0°	60.0°	80.0°
0 (= H_2O)	155	317	374	438	510
20	159	295	348	415	495
40	145	276	334	400	485
60	126	245	300	363	435
80	112	174	218	266	322
95	85	116	150	192	240
99.9	61	89	120	157	205

The published paper gives the results only in the form of a diagram. The above numerical values were kindly supplied by the authors.

SULFONAL $(CH_3)_2C(SO_2C_2H_5)_2$

Freezing-points of mixtures of Sulfonal and Pyramidon are given by Kofler, 1949.

TRIETHYLENE TETRAMINE $C_6H_{18}N_4$

The distribution coefficient of Triethylene Tetramine between Ethyl Ether and Water, for concentrations of 0.0638 millimols per liter in the ether layer divided by 933 millimols per liter in the water layer is 0.00026 at 21°. (Collander, 1949, quoted from Collander and Barlund, 1933).

PENTACHLORO TOLUENE $C_6Cl_5CH_3$

SOLUBILITY OF PENTACHLORO TOLUENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $C_6Cl_5CH_3$ in Saturated Solution
8.77	0.0083
19.92	0.0112
29.93	0.0153
41.88	0.0224

PHENYL ISOTHIOCYANATE (Phenyl Mustard Oil) C_6H_5NCS

FREEZING-POINTS OF MIXTURES OF PHENYL ISOTHIOCYANATE AND DIPHENYL AMINE
(Osilov and Trikonov, 1949)

t°	Mol. % $(C_6H_5)_2NH$		t°	Mol. % $(C_6H_5)_2NH$	t°	Mol. % $(C_6H_5)_2NH$
-21.8		0.0	-12.0	20.0	25.8	55.0
-25.2		5.0	+11.4	40.0	29.9	60.0
-28.4	(Eutec.)	9.1	16.3	45.0	43.5	80.0
-23.0		12.5	20.9	50	53.8	100.0

TRINITRO TOLUENE 2, 4, 6- $(NO_2)_3C_6H_2CH_3$

Freezing-point data are given for:

Trinitro Toluene + Anesthesin (Kofler, 1949)
Trinitro Toluene + Fluorene (Kofler, 1948)
Trinitro Toluene + Tetryl (Howson, Mulvaney, and Evans, 1949)
Trinitro Toluene + RDX (Campbell and Kushnarov, 1947)
Trinitro Toluene + NENO (Campbell and Kushnarov, 1947)

BENZALDEHYDE C_6H_5CHO

SOLUBILITY OF BENZALDEHYDE IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES
(Booth and Everson, 1949)

Gms. Na Sulfonate per 100 gms. Aq. Solvent	cc C_6H_5CHO per 100 cc Solvent in Aqueous:							
	Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0.0	0.40	0.96	0.40	0.96	0.40	0.96	0.40	0.96
5.0	0.60	1.10	1.06	1.10	0.90	1.05	1.00	1.08
10.0	0.70	1.16	2.20	2.69	1.09	1.44	1.50	1.81
20.0	1.05	1.89	7.70	8.62	2.56	3.22	4.60	5.12
32.0	2.53	3.81	--	--	--	--	--	--
34.5	--	--	28.9	34.5	--	--	--	--
40.0	--	--	--	--	11.6	15.7	24.2	28.9

BENZOIC ACID C_6H_5COOH

SOLUBILITY OF BENZOIC ACID IN AQUEOUS SOLUTIONS OF SODIUM MONOCHLORO ACETATE
(Bhagwat, 1939)

t°	Gm. Mols. per liter		t°	Gm. Mols. per liter	
	$CH_2ClCOONa$	C_6H_5COOH		$CH_2ClCOONa$	C_6H_5COOH
25.4	0.0	0.02763	29.6	0.0	0.03237
25.4	0.10830	0.03662	29.6	0.01062	0.03433
25.4	0.18050	0.03989	29.6	0.02083	0.03697
25.4	0.54160	0.05101	29.6	0.04923	0.03858
26.6	0.0	0.02943	29.6	0.10830	0.04185
26.6	0.01321	0.03109	29.6	0.18050	0.04610
26.6	0.02570	0.03289	29.6	0.54160	0.05657
26.6	0.06018	0.03597			
26.6	0.27080	0.04479			

SOLUBILITY OF BENZOIC ACID IN AQUEOUS SOLUTIONS OF SODIUM TRICHLORO ACETATE

(Bhagwat, 1939)

t°	Gm. Mols. per liter		t°	Gm. Mols. per liter	
	CCl_3COONa	C_6H_5COOH		CCl_3COONa	C_6H_5COOH
28.2	0.00	0.03057	30.0	0.00	0.03237
28.2	0.1741	0.0318	30.0	0.0490	0.03155
28.2	0.2691	0.0327	30.0	0.1076	0.03188
28.2	0.5382	0.0368	30.0	0.2691	0.03351
			30.0	0.5382	0.03400

SOLUBILITY OF BENZOIC ACID IN AQUEOUS SOLUTIONS OF SODIUM AMINO BENZOATE

(Bhagwat, 1939)

t°	Gm. Mols. per liter		t°	Gm. Mols. per liter	
	$NH_2C_6H_4COONa$	C_6H_5COOH		$NH_2C_6H_4COONa$	C_6H_5COOH
28.2	0.0	0.03574	28.2	0.03268	0.06049
28.2	0.01090	0.03957	28.2	0.04902	0.06294
28.2	0.01634	0.04447	28.2	0.09804	0.07848

SOLUBILITY OF BENZOIC ACID IN AQUEOUS SOLUTIONS OF SODIUM PROPIONATE

(Bhagwat, 1939)

t°	Gm. Mols. per liter		t°	Gm. Mols. per liter	
	C_2H_5COONa	C_6H_5COOH		C_2H_5COONa	C_6H_5COOH
28.1	0.0	0.03165	28.1	0.29830	0.19278
28.1	0.02082	0.05035	28.1	0.44740	0.23736
28.1	0.08130	0.09380	28.1	0.89480	0.30411
28.1	0.17890	0.13758			

DISTRIBUTION OF BENZOIC ACID BETWEEN WATER AND ORGANIC SOLVENTS

(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration in the latter by difference. The distribution coefficient K is the concentration in the H_2O layer (approx. 0.1%) divided by the concentration in the organic solvent layer.

Solvent in Contact with H_2O	Distribution Coefficient K Conc. H_2O ÷ conc. Org. Solvent
Benzene	0.47
Chloroform	0.27 - 0.48
Carbon Tetrachloride	0.69
Skellysolve B	1.4 - 3.1

In the case of n Butanol, Cyclohexanone, Methyl Ethyl Ketone, Methyl Propyl Ketone, Ethyl Acetate, Methyl Isobutyl Ketone, Ethyl Ether, Butyl Acetate and Diisopropyl Ketone the distribution coefficient was equal to or less than 0.1.

The distribution coefficient of Benzoic Acid between Ethyl Ether and Water, for concentrations of 132 - 1109 millimols per liter of the ether layer divided by 1.9 - 14.2 millimols per liter of the water layer, is 70 - 78 at about 20°. (Collander, 1949).

SOLUBILITY OF BENZOIC ACID IN FURFURAL
(Trimble, 1941)

$t_{t°}$	Gms. C_6H_5COOH per 100 gms. Sat. Sol.
0	1.2
25	14.8
40	34.3

Freezing-point data for mixtures of Benzoic Acid and Palmitin are given by Efremov, Vinogradova, and Tichomirova, 1937.

Corrections to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 513, last table, The heading of the last column should read Gms. C_6H_5COOH per 100 gms. Solvent. Page 515, second table, the results are in terms of Mol. Fractions instead of Gm. Mols. C_6H_5COOH per 100 gm. mols. sat. sol. Page 516, the 3rd. and 4th. sentences from bottom of page should be changed to read, The demixing temperature instead of The critical solution temperature.

SALICYLIC ACID o OHC_6H_4COOH.

SOLUBILITY OF SALICYLIC ACID IN AQUEOUS SOLUTIONS OF SODIUM MONOCHLORO ACETATE
(Bhagwat, 1939)

t°	Gm. Mols. per liter		t°	Gm. Mols. per liter	
	$CH_2ClCOONa$	HOC_6H_4COOH		$CH_2ClCOONa$	HOC_6H_4COOH
25	0.00	0.01896	25	0.14770	0.05346
25	0.01320	0.02518	25	0.27080	0.07280
25	0.02570	0.02845	25	0.54160	0.09810
25	0.03788	0.03237	28.2	0.00	0.01782
25	0.04923	0.03466	28.2	0.01320	0.02354
25	0.06020	0.03760	28.2	0.03788	0.03106
25	0.08068	0.04186	28.2	0.09020	0.04185
25	0.10830	0.04611	28.2	0.18050	0.05673
			28.2	0.54160	0.07701

SOLUBILITY OF SALICYLIC ACID IN AQUEOUS SOLUTIONS OF SODIUM TRICHLORO ACETATE
(Bhagwat, 1939)

t°	Gm. Mols. per liter	
	CCl_3COONa	HOC_6H_4COOH
30.5	0.0	0.02125
30.5	0.04900	0.02190
30.5	0.01794	0.02240
30.5	0.05382	0.02422

SOLUBILITY OF SALICYLIC ACID IN AQUEOUS SOLUTIONS OF SODIUM AMINO BENZOATE

(Bhagwat, 1939)

t°	Gm. Mols. per liter	
	$NH_2C_6H_4COONa$	HOC_6H_4COOH
29.1	0.00	0.01847
29.1	0.01090	0.02747
29.1	0.01634	0.03433
29.1	0.03268	0.03171
29.1	0.04902	0.02877
29.1	0.09804	0.02943

t°	Gm. Mols. per liter	
	$NH_2C_6H_4COONa$	HOC_6H_4COOH
28.3	0.0	0.01782
28.3	0.00891	0.02518
28.3	0.01090	0.02714
28.3	0.01634	0.03221
28.3	0.03268	0.03204
28.3	0.04902	0.02812
28.3	0.09804	0.02877

SOLUBILITY OF SALICYLIC ACID IN AQUEOUS SOLUTIONS OF SODIUM PROPIONATE

(Bhagwat, 1939)

t°	Gm. Mols. per liter	
	C_2H_5COONa	HOC_6H_4COOH
27.8	0.0	0.01795
27.8	0.02082	0.03589
27.8	0.08130	0.09264
27.8	0.09940	0.10827

t°	Gm. Mols. per liter	
	C_2H_5COONa	HOC_6H_4COOH
27.8	0.17890	0.17659
27.8	0.29830	0.27155
27.8	0.44740	0.37982
27.8	0.89480	0.73301

SOLUBILITY OF SALICYLIC ACID IN AQUEOUS SOLUTIONS OF ACETAMIDE AT 20°

(Campbell and Campbell, 1940)

Gms. per 100 gms. Sat. Sol.		Solid Phase
CH_3CONH_2	HOC_6H_4COOH	
0.0	0.19	HOC_6H_4COOH
0.4	0.225	"
1.6	0.28	"
2.0	0.26	"
6.2	0.375	"
12.85	0.53	"

Gms. per 100 gms. Sat. Sol.		Solid Phase
CH_3CONH_2	HOC_6H_4COOH	
25.9	1.30	HOC_6H_4COOH
37.8	2.71	"
44.3	4.13	" + 1:1
48.9	4.24	1:1
52.4	4.91	"
64.5	7.53	1:1 + CH_3CONH_2
79.3	--	CH_3CONH_2

1:1 = $HOC_6H_4COOH \cdot CH_3CONH_2$

The distribution coefficient of Salicylic Acid between Ethyl Ether and Water, for concentrations of 356 millimols per liter in the ether layer divided by 2.8 millimols per liter in the water layer is 127 at 20°. (Collander, 1949).

SOLUBILITY OF SALICYLIC ACID IN FURFRUAL

(Trimble, 1941)

t°	Gms. HOC_6H_4COOH per 100 gms. Sat. Sol.
0	1.5
25	11.0
40	28.8

Freezing-points of mixtures of Salicylic Acid and Palmitin are given by Efremov, Vinogradova and Tichomirova, 1937.

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 527 second table, the results are in terms of Mol. Fractions instead of Gm. Mols. OHC_6H_4COOH per 100 gm. mols. sat. sol.

HYDROXY BENZOIC ACIDS m and p HOC_6H_4COOH

The distribution coefficient of m Hydroxy Benzoic Acid between Ethyl Ether and Water, for concentrations of 352 millimols per liter in the ether layer divided by 17.0 millimols per liter in the water layer is 21 at 19°. (Collander, 1949).

The distribution coefficient of p Hydroxy Benzoic Acid between Ethyl Ether and Water, for concentrations of 930 millimols per liter in the ether layer divided by 36.4 millimols per liter in the water layer is 26 at 20°. (Collander, 1949).

DINITRO TOLUENE 1, 2, 4 $C_6H_3CH_3(NO_2)_2$

Freezing-points of mixtures of 1, 2, 4 Dinitro Toluene and Naphthalene are given by Kofler, 1940.

DINITRO o CRESOL $(NO_2)_2C_6H_2(CH_3)OH$

Freezing-points of mixtures of Dinitro o Cresol and Ketociniol are given by Brambilla, 1942.

GALLIC ACID $(HO)_3C_6H_2COOH$

The distribution coefficient of Gallic Acid between Ethyl Ether and Water, for concentrations of 69.7 millimols per liter in the ether layer divided by 140 millimols per liter in the water layer is 0.50 at 21°. (Collander, 1949).

BENZAMIDE $C_6H_5CONH_2$

Freezing-points of mixtures of Benzamide and Phenacetine are given by Kofler, 1948.

NITRO TOLUENES o, m, p $C_6H_4CH_3NO_2$

Freezing-points are given for:

o Nitro Toluene + m Nitro Toluene (Levine and Stern, 1938)
o Nitro Toluene + p Nitro Toluene " "
m Nitro Toluene + p Nitro Toluene " "
p Nitro Toluene + 2, 4 Chloro Nitro Toluene (Magidson & Schewelioff,
p Nitro Toluene + 2, 6 Dichloro 4-Nitro Toluene " " 1935)
p Nitro Toluene + Naphthalene (Kofler, 1940)

AMINO BENZOIC ACIDS o, m, p $NH_2C_6H_4COOH$

SOLUBILITY OF p AMINO BENZOIC ACID IN WATER AND IN AQUEOUS SOLUTIONS OF p SULFONAMIDE (Sulfanilamide)

(Caronna, 1948)

Gms. p Sulfonamide per 100 gms. Sat. Sol.	Gms. p $NH_2C_6H_4COOH$ per 100 gms. Sat. Sol.	
	At 18°	At 30°
0.0 (=H_2O)	4.95	6.11
0.25	6.03	6.37
0.50	6.04	6.40
1.00	6.03	6.42
2.00	6.05	7.07
3.00	6.08	7.12
4.00	6.12	7.43

DISTRIBUTION OF o, m and p AMINO BENZOIC ACIDS BETWEEN ETHYL ETHER AND WATER AT 19°

(Collander, 1949)

Amino Benzoic Acid	Millimols per liter in:		Distribution Coefficient
	Ether Layer (a)	Water Layer (b)	a/b
o $NH_2C_6H_4COOH$	199	7.40	27
m "	46	31.4	1.5
p "	420	55.0	7.6

ANTHRANILIC ACID

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 540 first table, change heading Water and Acetone to Glycerol and Acetone

TOLUENE $C_6H_5CH_3$

RECIPROCAL SOLUBILITY OF TOLUENE AND PERFLUORO METHYL CYCLOHEXANE ($C_6H_{11}CF_3$)

(Hildebrand and Cochran, 1949)

The sealed tube method was used and the consolute temperature observed during slow cooling of the mixtures.

t°	Vol. Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of $C_6H_5CH_3$	t°	Vol. Fraction of $C_6H_{11}CF_3$*	Mol. Fraction of $C_6H_5CH_3$
63.7	0.900	0.943	87.2	0.400	0.550
83.1	0.800	0.880	82.0	0.300	0.440
87.7	0.700	0.810	63.7	0.200	0.314
88.9	0.600	0.733	42.8	0.100	0.169
88.6	0.500	0.647			

* measured at 25°

THE CRITICAL SOLUTION TEMPERATURE OF MIXTURES OF TOLUENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Ethylene Glycol	210	Triethylene Glycol	90
Ethanol Amine	137	Ethylene Diformate	15
Diethylene Glycol	134	Ammonia	-5
Resorcinol	128	Furfural	< -60.7
Lactic Acid	100		

RECIPROCAL SOLUBILITY OF TOLUENE, DECANE AND ANILINE

(Powers, 1949)

t°	Gms. per 100 gms. Sat. Sol.			t°	Gms. per 100 gms. Sat. Sol.		
	$C_6H_5CH_3$	$C_{10}H_{22}$	$C_6H_5NH_2$		$C_6H_5CH_3$	$C_{10}H_{22}$	$C_6H_5NH_2$
77	-	20	80	47	12	17	71
78	-	40	60	55	9	20	71
77	-	60	40	41	15	14	71
72	-	67	33	56	11	26	63
66	-	75	25	45	15	22	63
58	-	80	20	38	19	19	62
47	-	78	12	54	14	31	55
49	5	12	83	42	18	26	56
40	7	10	83	31	22	22	55
33	9	8	83	52	15	35	50

RECIPROCAL SOLUBILITY OF TOLUENE, OCTADECANE AND ANILINE

(Powers, 1949)

t°	Gms. per 100 gms. Sat. Sol.			t°	Gms. per 100 gms. Sat. Sol.		
	$C_6H_5CH_3$	$C_{18}H_{38}$	$C_6H_5NH_2$		$C_6H_5CH_3$	$C_{18}H_{38}$	$C_6H_5NH_2$
98	-	20	80	69	14	14	72
103	-	40	60	84	10	23	67
98	-	60	40	86	11	26	63
94	-	67	33	73	15	22	63
87	-	75	25	65	19	19	62
81	-	80	20	81	13	31	56
63	-	78	12	69	18	26	56
75	7	10	83	60	22	22	56
67	8	8	84	77	15	35	50
77	11	17	72				

Freezing-points are given by Krevenko, 1949 for:

Toluene + o Xylene
Toluene + p Xylene
Toluene + Ethyl Benzene

PHENYL UREA $C_6H_5NHCONH_2$

The distribution coefficient of Phenyl Urea between Ethyl Ether and Water, for concentrations of 77.5 millimols per liter in the ether layer divided by 70.4 millimols per liter in the water layer is 1.1 at 18°. (Collander, 1949).

CRESOLS, o and p $CH_3C_6H_4OH$

SOLUBILITY OF o CRESOL IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES
(Booth and Everson, 1949)

Gms. Na Sulfonate per 100 gms. Aqueous Solvent	cc o $CH_3C_6H_4OH$ per 100 cc Aqueous Solvent in:							
	Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0.0 (=H_2O)	2.20	3.08	2.20	3.08	2.20	3.08	2.20	3.08
5.0	2.74	3.46	13.0	11.3	3.36	3.54	7.8	6.4
8.0	--	--	33.6	27.2	--	--	--	--
10.0	3.66	4.25	--	--	32.5	18.4	--	--
15.0	22.0	11.3	66.3	74.3	272.0	283.0	236.4	275.0
20.0	>400.0	>400.0	82.7	92.0	>400.0	>400.0	>400.0	>400.0
32.0	>400.0	>400.0	--	--	--	--	--	--
34.6	--	--	188.3	198.4	--	--	--	--
40.0	--	--	--	--	>400.0	>400.0	>400.0	>400.0

Freezing-points of mixtures of p Cresol and Ketocineol are given by Brambilla, 1942.

BENZYL ALCOHOL $C_6H_5CH_2OH$

RECIPROCAL SOLUBILITY OF BENZYL ALCOHOL AND WATER
(Hückel, Niesel, and Büchs, 1944)

t°	Gms. $C_6H_5CH_2OH$ per 100 gms.		t°	Gms. $C_6H_5CH_2OH$ per 100 gms.	
	H_2O rich Phase	Alcohol rich Phase		H_2O rich Phase	Alcohol rich Phase
20	3.92	95.14	40	4.14	92.79
25	3.98	94.73	45	4.196	92.45
30	4.07	93.91	50	4.194	92.08
35	4.105	93.42	55	4.365	91.38

GUAIACOL

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, p. 551 first sentence, change the critical solution temperature to The demixing temperature etc.

THEOPHYLLINE $C_7H_8O_2N_4$

SOLUBILITY OF THEOPHYLLINE IN AQUEOUS SOLUTIONS OF AMINES AT 25°

(Leuallen and Osol, 1949)

Results for aqueous solutions of.

Monomethyl Amine

Gram mols. per liter	
CH_3NH_2	$C_7H_8O_2N_4$
0.5364	0.8399
0.7903	1.200
1.028	1.520
1.244	1.783
1.696	2.293
1.802	2.409
1.809	2.376
1.991	1.848
3.691	1.594
3.779	1.376

Dimethyl Amine

Gram mols. per liter	
$(CH_3)_2NH$	$C_7H_8O_2N$
0.3081	0.5140
0.6355	0.985
1.008	1.470
1.238	1.743
1.695	2.235
1.765	2.302
2.356	2.868
2.955	3.259

Trimethyl Amine

Gram mols. per liter	
$(CH_3)_3N$	$C_7H_8O_2N$
0.2525	0.3905
0.5164	0.7367
0.8411	1.093
1.078	1.376
1.532	1.743
1.930	2.060
2.418	2.366

Results for aqueous solutions of:

Monoethyl Amine

Gram mols. per liter	
$C_2H_5NH_2$	$C_7H_8O_2N_4$
0.4982	0.7818
1.021	1.480
1.750	2.305
1.812	2.357
2.327	2.869
2.406	2.677
2.437	2.666
2.806	2.397

Diethyl Amine

Gram mols. per liter	
$(C_2H_5)_2NH$	$C_7H_8O_2N_4$
0.4723	0.7462
1.066	1.503
1.335	1.813
1.379	1.864
2.170	2.558
2.660	2.916

Mono n Propyl Amine

Gram mols. per liter	
$C_3H_7NH_2$	$C_7H_8O_2N_4$
0.7020	1.080
1.115	1.620
2.458	2.913
2.605	2.895
2.918	2.730
3.321	2.553
3.687	2.446

Results for aqueous solutions of:

Di n Propyl Amine

Gram mols. per liter	
$(C_3H_7)_2NH$	$C_7H_8O_2N_4$
0.4398	0.6965
0.7925	1.163
1.281	1.680
1.356	1.735
1.400	1.804
1.556	1.945
2.207	2.399
2.243	2.436

Mono n Butyl Amine

Gram mols. per liter	
$(C_4H_9)NH_2$	$C_7H_8O_2N_4$
0.6063	0.9379
1.154	1.629
2.481	2.863
2.499	2.886
2.721	3.071
2.811	3.087
2.880	3.030
4.132	2.605
4.491	2.489

Di n Butyl Amine

Gram mols. per liter	
$(C_4H_9)_2 \cdot NH$	$C_7H_8O_2N_4$
0.3396	0.5580
0.5379	0.8190
0.6707	0.9954
1.238	1.636
1.822	2.110
1.940	2.196
2.125	2.278
2.490	2.460
2.694	2.502

2, 6-LUTIDINE (Dimethyl Pyridine) PHTHALATE $[(CH_3)_2C_5H_3N]_4[C_6H_4(COOH)_2]_5$

100 gms. Abs. C_2H_5OH dissolve 7.19 gms. 2, 6 Lutidine Phthalate at 18-20°
" 96% " " 6.66 " " " " " "
" Acetone " 2.82 " " " " " "
(Grigorowsky and Kimen, 1945)

BENZYLAMINE $C_6H_5CH_2NH_2$

The distribution coefficient of Benzylamine between Ethyl Ether and Water, for concentrations of 67.6 millimols per liter in the ether layer divided by 35.9 millimols per liter in the water layer is 1.9 at 18°. (Collander, 1949).

TOLUIDINE

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds p. 559 second table, Change Methylhexane to Methyl Cyclohexane and add -8.3 as its Critical solution temperature.

ETHYL CARBOTHIOLON MALIC ACID (+) (-) (rac) $C_7H_{10}O_5$

XANTOGEN SUCCINIC ACID (+) (-) $C_7H_{10}O_5$

SOLUBILITY OF EACH SEPARATELY AND OF MIXTURES OF THE ISOMERS IN WATER
(Fredga, 1940a)

Compound	Gms. Compound per liter Sat. Sol.
(rac) Xantogen Succinic Acid (I)	8.15
(+) " " " (I)	24.22
(rac) Ethyl Carbothiolon Malic Acid (II)	5.98
(+) " " " " (II)	24.88
(+) I and (+) II (Active Racemate)	24.33
(-) I and (+) II (Conglomerate)	158.5
(rac) I and (rac) II (Conglomerate)	14.19

Freezing-points of various mixtures of the optically active Isomers of Ethyl Carbothiolon Malic Acid and Xantogen Succinic Acid are given by Fredga, 1940.

β CARBOXY ADIPIC ACID $COOH(CH_2)_3CH(COOH)(COOH)$

DISTRIBUTION OF β CARBOXY ADIPIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

Note - The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration of the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.16%) divided by the conc. in the organic solvent layer.

Organic Solvent in contact with H_2O	Dist. Coef. K: Conc. in H_2O / Conc. in Org. Solvent	Organic Solvent in contact with H_2O	Dist. Coef. K: Conc. in H_2O / Conc. in Org. Solvent
n Butanol	0.83	Diiso Propyl Ketone	10 +
Ethyl Acetate	3.2	Butyl Acetate	10 +
Ethyl Ether	10 +	Methyl Isobutyl Ketone	6.8
Chloroform	10 +	Methyl Propyl Ketone	2.2
Skellysolve B	10 +	Methyl Ethyl Ketone	1.0
Carbon Tetrachloride	10 +	Cyclohexanone	0.74
Benzene	10 +		

β METHYL ADIPIC ACID $COOH(CH_2)_3CH(CH_3)COOH$

SOLUBILITY OF β METHYL ADIPIC ACID IN WATER
(Attane and Donmani, 1949)

t°	Gms. $C_7H_{12}O_4$ per 100 gms. H_2O	t°	Gms. $C_7H_{12}O_4$ per 100 gms. H_2O
0.0	4.47	29.8	42.6
9.5	6.82	33.2	68.2
12.8	8.20	41.1	146.5
20.0	14.43	52.3	295.
25.9	24.8	64.3	591.

PIMELIC ACID $(CH_2)_5(COOH)_2$

DISTRIBUTION OF PIMELIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

See Note under β Carboxy Adipic Acid p.689

Results for Distribution Coefficient K in:

$\frac{H_2O}{\text{n Butanol}}$	$\frac{H_2O}{\text{Ethyl Acetate}}$	$\frac{H_2O}{\text{Ethyl Ether}}$	$\frac{H_2O}{\text{Chloroform}}$	$\frac{H_2O}{\text{Skellysolve B}}$
0.15 - 0.17	0.38	0.91	10 +	10 +

Freezing-points are given by Houston and VanSandt, 1946, for:

Pimelic Acid + Suberic Acid
Pimelic Acid + Azelaic Acid

DIETHYL MALONIC ACID $C(C_2H_5)_2(COOH)_2$

The distribution coefficient of Diethyl Malonic Acid between Ethyl Ether and Water, for concentrations of 48.1 millimols per liter of the ether layer divided by 9.25 millimols per liter of the water layer is 5.2 at 19°. (Collander, 1949).

DIACETIN $C_3H_5(OH)(OOCCH_3)_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Diacetin between Ethyl Ether and Water, for a concentration of about 500 millimols per liter in the water layer is 0.22 at 20°. (Collander, 1949, quoted from Bärlund, 1929).

QUINIC ACID $(HO)_4C_6H_7COOH$

The distribution coefficient of Quinic Acid between Ethyl Ether and Water, for concentrations of 0.4 millimols per liter of the ether layer divided by 1304 millimols per liter of the water layer is 0.00031 at 21°. (Collander, 1949).

HEPTENE-1 $CH_2:CH(CH_2)_4CH_3$

SOLUBILITY OF WATER IN HEPTENE-1 AT 1.0 ATMOSPHERE PRESSURE

(Black, Joris, and Taylor, 1948)

The determinations were made by the use of Tritium Oxide as a tracer.

t° of Saturation	Sat. Time, Hours	Solubility in: Mols. H_2O per 100 mols. C_7H_{14}	Gms. H_2O per 100 gms. C_7H_{14}
10	6.0	0.3774	0.0692
20.1	6.5	0.6139	0.1126
20.5	4.5	0.5710	0.1047
21.2	6.3	0.6310	0.1158

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF HEPTENE-1 AND VARIOUS SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetic Anhydride	24	Diphenyl Ethylene Diamine	52
Chloro Acetic Acid	70	3, 4-Nitro Amino Toluene	114
Phthalic Anhydride	129	o Phenetidine	-16
Anthranilic Acid	149	p Phenetidine	41
Methanol	12	Ethyl Aceto Acetate	-2
Diacetone Alcohol	-32	Ethyl Lactate	-25
Methyl Cellosolve	-10	Ethyl Oxalate	-26
Methyl Carbitol	57	Methyl Anthranilate	-13
Carbitol	-25	Phenyl Phthalate	79
Ethylene Dichlorohydrin	74	Sulfur Dioxide	-21
Furfuryl Alcohol	76	Acetonyl Acetone	11
Tetrahydro Furfuryl Alcohol	15	p Nitro Benzyl Chloride	47
Benzyl Alcohol	-8	m Dinitro Benzene	149
Phenyl Ethanol	-14	2, 4 Dinitro Chloro Benzene	127
Cinnamyl Alcohol	47	m Cresol	< -52
Dicroton	< -78	Cresylic Acid	-60
Aldol	-26	o Benzyl Phenol	3
Furfural	56	Eugenol	-44
Benzaldehyde	< -50	m Hydroxy Diphenyl	< 56
Salicyl Aldehyde	-3	Acetanilide	134
Aniline	26	n Butyramide	141
o Toluidine	-25	Chlorex	-22
α Naphthylamine	58	α Naphthonitrile	5
p Amino Diphenyl	70		

METHYL CYCLOHEXANE $CH_3C_6H_{11}$

THE CRITICAL SOLUTION TEMPERATURE OF MIXTURES OF METHYL CYCLOHEXANE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetanilide	123	Ethylene Diacetate	29
Acetic Acid	7	Ethylene Dichlorhydrin	89
Acetic Anhydride	56	Eugenol	-30
Acetone	-3	Furoic Acid	112
Acetonitrile	78	Furfural	76
Acetonyl Acetone	39	Furfuryl Alcohol	93
Acetophenone	-17	m Hydroxy Diphenyl	60
Aldol	1	Methanol	47
p Amino Diphenyl	72	Methyl Anthranilate	15
Ammonia	63	Methyl Carbitol	68
Aniline	41	Methyl Cellosolve	26
Anthranilic Acid	132	Methyl Furoate	36
Amyl Fuorate	-70	Methyl Sulfate	124
Benzaldehyde	-15	β Naphthol	58
Benzoic Anhydride	28	α Naphthonitrile	85
Benzyl Alcohol	14	β Naphthonitrile	35
o Benzyl Phenol	10	α Naphthylamine	65
Butyl Fuorate	-50	β Naphthylamine	79
Butyramide	139	m Nitro Acetophenone	110
Carbitol	< -40	Nitro Amino Toluene	113
Carbon Dioxide	-41	Nitro Benzene	-3
Cellosolve	-40	o Nitro Aniline	147
Chloro Acetic Acid	98	p Nitro Benzyl Chloride	63
o Chloro Aniline	-17	o Nitro Chloro Benzene	12
o Chloro Phenol	-27	Nitro Methane	90
p Chloro Phenol	21	o Nitro Phenol	24
Chlorex	-7	o Nitro Toluene	-20
Cinnamyl Alcohol	51	o Phenetidine	-1
o Cresol	-29	p Phenetidine	54
m Cresol	-27	Phenol	11
p Cresol	-38	Phenyl Ethanol	-10
Cresylic Acid	-37	Phenyl Hydrazine	86
Croton Aldehyde	-25	Phenyl α Naphthylamine	0
Diacetone Alcohol	-5	Phenyl Phthalate	63
Dicroton	-41	Phthalic Anhydride	132
Dinitro Chloro Benzene	132	n Propyl Furoate	-44
Diphenyl Ethylene Diamine	48	Pyridine	-40
Ethyl Aceto Acetate	26	Salicyl Aldehyde	10
Ethyl Formate	-36	Sulfur Dioxide	16
Ethyl Fuorate	-1	Tetrahydro Furfuryl Alcohol	50
Ethyl Lactate	-1	o Toluidine	-3
Ethyl Oxalate	5	Triphenyl Phosphate	27
		Xylidines	-46

DIPROPYL KETONE $C_3H_7COC_3H_7$

DIISOPROPYL KETONE $(CH_3)_2CHCOCH(CH_3)_2$

METHYL n AMYL KETONE $CH_3CO(CH_2)_4CH_3$

SOLUBILITY OF DIPROPYL KETONE, DIISOPROPYL KETONE AND METHYL n AMYL KETONE, EACH SEPARATELY, IN WATER
(Saylor, Baxt, and Gross, 1942)

t°	Dipropyl Ketone		Diisopropyl Ketone		Methyl n Amyl Ketone	
	d_4^t	Mols. $C_7H_{14}O$ per 1000gms. H_2O	d_4^t	Mols. $C_7H_{14}O$ per 1000gms. H_2O	d_4^t	Mols. $C_7H_{14}O$ per 1000gms. H_2O
0	0.8340	0.0643	-	-	-	-
10	0.8248	0.0466	0.8139	0.0587	0.8245	0.0472
30	0.8081	0.0331	0.7968	0.0404	0.8072	0.0355
40	-	-	0.7869	0.0392	-	-
50	0.7913	0.0288	0.7792	0.0350	0.7898	0.0319
55	-	-	0.7734	0.0339	-	-
60	-	-	-	-	0.7809	0.0308
65	-	-	0.7645	0.0331	0.7761	0.0315
75	0.7702	0.0254	0.7560	0.0376	0.7676	0.0339

Computed values for the vapor solubilities are also given.

2, 4 DIMETHYL PENTANONE-3 $(CH_3)_2CHCOCH(CH_3)_2$

RECIPROCAL SOLUBILITY OF 2, 4-DIMETHYL PENTANONE-3 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_7H_{14}O$ per 100 gms:	
	H_2O rich layer	$C_7H_{14}O$ rich layer
20	0.59 (0.9976)	99.24 (0.8044)
25	0.57 (0.9966)	99.19 (0.8003)
30	0.56 (0.9953)	99.15 (0.7962)

The figures in parentheses are the densities at the respective temperatures.

HEPTANONE-2 $CH_3CO(CH_2)_4CH_3$

RECIPROCAL SOLUBILITY OF HEPTANONE-2 AND WATER
(Ginnings, Plonk, and Carter, 1940)

t°	Gms. $C_7H_{14}O$ per 100 gms.	
	H_2O rich layer	$C_7H_{14}O$ rich layer
20	0.44 (0.9978)	98.69 (0.8177)
25	0.43 (0.9967)	98.59 (0.8141)
30	0.40 (0.9953)	98.48 (0.8098)

The figures in parentheses are the densities at the respective temperatures.

HEPTYLIC ACID $CH_3(CH_2)_5COOH$

SOLUBILITY OF HEPTYLIC ACID IN WATER
(Ralston and Hoerr, 1942)

t°	Gms. $C_7H_{14}O_2$ per 100 gms. H_2O	t°	Gms. $C_7H_{14}O_2$ per 100 gms. H_2O
0	0.864	30	1.019
15	0.882	45	1.095
20	0.968 (1.08)	60	1.171

The Eutectic of mixtures of Heptylic and Acetic Acids is at -6.5° and 98.8 wt. % $CH_3(CH_2)_5COOH$. (Ralston and Hoerr, 1942).

METHYL GLUCOSIDE $C_7H_{14}O_6$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Methyl Glucoside between Ethyl Ether and Water, for a concentration of about 1500 millimols per liter in the water layer is 0.00005 at about 20°. (Collander, 1949, quoted from Collander and Bärlund, 1929).

HEPTANE n $CH_3(CH_2)_5CH_3$

SOLUBILITY OF WATER IN n HEPTANE AT 1.0 ATMOSPHERE PRESSURE
(Black, Joris, and Taylor, 1948)

t° of Saturation	Solubility in terms of: Mols. H_2O per 100 mols. C_7H_{16}	Gms. H_2O per 100 gms. H_2O
10	0.0429	0.0077
20	0.0757	0.0136
20	0.0701	0.0126
25	0.0840	0.0151

SOLUBILITY OF n HEPTANE IN AQUEOUS SOLUTIONS OF POTASSIUM TETRADECANOATE AT 25° (?)
(Harkins and Oppenheimer, 1949)

Gms. per 1000 gms. Sat. Sol. K Tetradecanoate	Gms. per 1000 gms. Sat. Sol. C_7H_{16}	Gms. per 1000 gms. Sat. Sol. K Tetradecanoate	Gms. per 1000 gms. Sat. Sol. C_7H_{16}
0.0 (= H_2O)	0.07	0.747	8.8
0.050	0.39	0.869	10.5
0.104	0.58	1.00	12.7
0.203	1.92	1.49	21.0
0.302	2.9	2.01	29.5
0.504	5.3		

The temperature is not stated but is probably 25°C.

The aniline point of n Heptane is 70.6 and the Critical Solution Temperature with aniline is 70.8°. (Ludeman, 1940).

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF n HEPTANE AND VARIOUS SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetic Acid	10.5	Ethyl Formate	-34
Acetic Anhydride	68	Ethyl Acetate	< -78
Propionic Acid	< -70	Ethyl Aceto Acetate	43
Chloro Acetic Acid	137	Ethyl Lactate	21
Furoic Acid	168	Ethyl Oxalate	23.5
Benzoic Anhydride	79	Butyl Oxalate	-55
Phthalic Anhydride	186	Methyl Furoate	57
Anthranilic Acid	204	Ethyl Furoate	20
Methanol	51	n Propyl Furoate	-24
Ethanol	< -60	n Butyl Furoate	-22
n Propanol	< -78	n Amyl Furoate	-32
Iso Propanol	< -78	Methyl Anthranilate	46
n Butanol	< -78	Phenyl Phthalate	135
Iso Butanol	< -78	Triphenyl Phosphite	91
sec Butanol	< -78	Ammonia	63
Iso Amyl Alcohol	< -78	Carbon Dioxide	-51
Diacetone Alcohol	8	Sulfur Dioxide	19.4
Methyl Cellosolve	48	Acetone	-28
Cellosolve	-12	Acetonyl Acetone	68
Methyl Carbitol	104	Acetophenone	4
Carbitol	25	Quinone	108
Ethylene Chlorohydrin	108	Nitro Benzene	17.5
Furfuryl Alcohol	115	o Nitro Toluene	-1
Tetrahydro Furfuryl Alcohol	82	o Nitro Phenol	43
Benzyl Alcohol	60	o Nitro Chloro Benzene	41
Phenyl Ethanol	34	p Nitro Benzyl Chloride	103
Cinnamyl Alcohol	102	2-Nitro-4-Methyl Phenol	18
Croton Aldehyde	-14	2, 4-Dinitro Chloro Benzene	187
Dicroton	-24	Phenol	53
Aldol	36	o Cresol	9
Paraldehyde	-54	m Cresol	14
Furfural	95	p Cresol	12
Benzaldehyde	3	Cresylic Acid	0
Salicyl Aldehyde	34	o Chloro Phenol	6
Aniline	70	p Chloro Phenol	67
o Toluidine	25	2, 4-Xylen-1-ol	-60
Xylidines	-23	o Benzyl Phenol	67
Methyl Aniline	0	Eugenol	3
α Naphthylamine	113	o Hydroxy Diphenyl	28
β Naphthylamine	131	m Hydroxy Diphenyl	121
o Amino Diphenyl	43	β Naphthol	130
p Amino Diphenyl	125	Acetonitrile	84
Diphenyl Amine	26	Acetanilide	204
Diphenyl Ethylene Diamine	103	n Butyramide	178
Phenyl α Naphthylamine	63	Chlorex	15.5
o Chloro Aniline	13	Dioxane	-4
p Chloro Aniline	80	α Naphthonitrile	67
o Nitro Aniline	206	β Naphthonitrile	74
3,4-Nitro Amino Toluene	173	Pyridine	-21
o Phenetidine	28		
p Phenetidine	83		

Freezing-point data are given by Kravchenko, 1949 for:

n Heptane + n Octane
n Heptane + n Decane
n Heptane + n Decane + n Octane

2-METHYL HEXANE $(CH_3)_2CH(CH_2)_2CH_2CH_3$

The aniline point of 2-Methyl Hexane is 72.8° and the Critical Solution Temperature with aniline is 74.1°. (Ludeman, 1940, quoted from Garner, 1928).

HEPTANOL 1- $CH_3(CH_2)_5CH_2OH$

SOLUBILITY OF n HEPTANOL IN AQUEOUS SOLUTIONS OF POTASSIUM DODECANOATE AND OF POTASSIUM TETRADECANOATE AT 25° (?)

(Harkins and Oppenheimer, 1949)

A series of mixtures of the soap solution and the alcohol were shaken and, after attainment of equilibrium, the turbidities of the mixtures were determined by use of a photometer. A plot of the turbidity against amount of alcohol showed a break in the curve at the point of saturation.

Mols. per 1000 gms. Solution		Mols. per 1000 gms. Solution	
K Dodecanoate	$C_7H_{15}OH$	K Tetradecanoate	$C_7H_{15}OH$
0.0 (= H_2O)	0.0103	0.0 (= H_2O)	0.0103
0.0077	0.026	0.00774	0.026
0.0397	0.044	0.0397	0.044
0.132	0.108	0.132	0.103
0.200	0.163	0.200	0.163
0.275	0.210	0.275	0.210
0.386	0.273		

The temperature is not stated but is probably 25°C.

SOLUBILITY OF n HEPTANOL IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF THE HIGHER FATTY ACIDS AT 25° (?)

(Harkins and Oppenheimer, 1949)

Potassium Salt of:	Mols. $C_7H_{15}OH$ per 1000 gms. Soap Solution	Potassium Salt of:	Mols. $C_7H_{15}OH$ per 1000 gms. Soap Solution
Octylic Acid, $C_8H_{16}O_2$	0.096	Laurinic Acid, $C_{12}H_{24}O_2$	0.201
Nonylic Acid, $C_9H_{18}O_2$	0.139	Myristinic Acid, $C_{13}H_{26}O_2$	0.212
Capric Acid, $C_{10}H_{20}O_2$	0.188	Pentadecanoic ", $C_{14}H_{28}O_2$	0.226
Undecylic Acid, $C_{11}H_{22}O_2$	0.201	Na Dodecyl Sulfate	0.260

The saturated solutions were analyzed by turbidity measurement.

DIETHYL MALONAMIDE $C_7H_{16}O_2N_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Diethyl Malonamide between Ethyl Ether and Water, for a concentration of about 50 millimols per liter of the water layer is 0.012 at about 20°. (Collander, 1949, quoted from Collander and Bärlund, 1933).

GLYCEROL αα DIETHYL ETHER $C_7H_{16}O_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Glycerol αα Diethyl Ether between Ethyl Ether and Water, for a concentration of 670 millimols per liter of the water layer is 0.84 at 19°. (Collander, 1949).

1-HEPTANETHIOL $CH_3(CH_2)_5CH_2SH$

SOLUBILITY OF 1-HEPTANETHIOL IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF THE HIGHER FATTY ACIDS AT 25° (?)
(Harkins and Oppenheimer, 1949)

Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_7H_{15}SH$ per 1000 gms. Soap Solution	Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_7H_{15}SH$ per 1000 gms. Soap Solution
Octylic Acid	0.0007	Laurinic Acid	0.0393
Nonylic Acid	0.0014	Myristinic Acid	0.0591
Capric Acid	0.0102	Pentadecanoic Acid	0.090
Undecylic Acid	0.0171	Na Dodecyl Sulfate	0.0925

The saturated solutions were analyzed by turbidity measurement.

ETHYL PENTACHLORO BENZENE $C_6(C_2H_5)Cl_5$

SOLUBILITY OF ETHYL PENTACHLORO BENZENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $C_6(C_2H_5)Cl_5$ in Saturated Solution
22.12	0.468
32.36	0.645
42.57	0.851

TETRACHLORO o XYLENE $C_6Cl_4(CH_3)_2$

SOLUBILITY OF TETRACHLORO o XYLENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $C_6Cl_4(CH_3)_2$ in Saturated Solution
8.77	0.0077
19.92	0.0110
29.93	0.0150
41.88	0.0217

p BROM PHENACYL BROMIDE and CHLORIDE $BrC_6H_4COCH_2Br$

100 cc of Aqueous 62% C_2H_5OH dissolve 0.332 gm. $BrC_6H_4COCH_2Br$ at 25°.
100 cc of Aqueous 62% C_2H_5OH dissolve 0.278 gm. $BrC_6H_4COCH_2Cl$ at 25°.

Results are also given, in the form of a diagram, of the melting-points of mixtures of the two components (Pokras and Bernstein, 1943).

PHTHALIC ACIDS o and m $C_6H_4(COOH)_2$

100 gms. of saturated solution of o Phthalic Acid in Furfural contain 6.2 gms. o $C_6H_4(COOH)_2$ at 0° and 17.6 gms. at 25°. (Trimble, 1941).

The distribution coefficient of o Phthalic Acid between Ethyl Ether and Water, for concentrations of 9.1 to 32.2 millimols per liter in the ether layer divided by 8.5 to 26.1 millimols per liter in the water layer is 1.1 - 1.2 at 25°. (Collander, 1949, quoted from Chandler, 1908).

The distribution coefficient of m Phthalic Acid between Ethyl Ether and Water, for concentrations of 26.6 to 48.5 millimols per liter in the ether layer divided by 0.25 to 0.398 millimols per liter in the water layer is 10 - 12 at 25°. (Collander, 1949, quoted from Chandler, 1908).

Correction to Vol. 2, 3rd. Ed. Solubilities of Organic Compounds, p. 575, first table, change 2nd. and 4th. column headings to Mol. fractions $C_6H_4(COOH)_2$ instead of Gm. mols. $C_4H_4(COOH)_2$ per 100 mols. Sat. Sol.

TRICHLORO o XYLENE 3, 4, 5 $Cl_3C_6H(CH_3)_2$

SOLUBILITY OF 3, 4, 5 TRICHLORO o XYLENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $Cl_3C_6H(CH_3)_2$ in Saturated Solution
17.46	0.483
27.83	0.526
37.45	0.809

STYRENE $C_6H_5CH:CH_2$

RECIPROCAL SOLUBILITY OF STYRENE AND WATER
(Lane, 1946)

Results for the solubility of:

Water in Styrene		Styrene in Water	
t°	Gms. H_2O per 100 gms. Sat. Sol.	t°	Gms. $C_6H_5CH:CH_2$ per 100 gms. Sat. Sol.
6	0.032	7	0.029
14	0.040*	15	0.025*
25	0.066	25	0.032
27	0.060*	32	0.036
31	0.084	40	0.040
34	0.080*	44	0.040*
40	0.101	50	0.045
45	0.120*	56	0.050*
51	0.123	63	0.058

* By cloud point determination. The other results by analytical determination.

SOLUBILITY OF STYRENE IN AQUEOUS SOLUTIONS OF POTASSIUM OLEATE AT 20°
(Yurzhenko and Mintz, 1945)

Wt. % K Oleate in Aqueous Solvent	cc Styrene Dissolved per 100 cc Aqueous Solvent
0.75	0.62
1.50	2.2
3.00	6.8

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF STYRENE WITH SEVERAL ORGANIC SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture
Triethanol Amine	180
Ethanol Amine	115
Diethylene Glycol	111
Triethylene Glycol	37
Ethylene Diformate	-8

SOLUBILITY OF POLYSTYRENE IN MIXTURES OF DECANE AND TOLUENE

(Powers, 1949)

Two samples of commercial low molecular weight Polystyrene of different average degree of polymerization were used. The temperatures were determined at which on slow cooling, known mixtures of the resins and solvents became opaque.

Results for:

Resin Sample A				Resin Sample B			
t°	Gms. per 100 gms. Mixture			t°	Gms. per 100 gms. Mixture		
	Resin A	Decane	Toluene		Resin B	Decane	Toluene
5	90	10	-	30	90	10	-
43	80	20	-	80	80	20	-
71	70	30	-	123	70	30	-
35	50	50	-	68	77	18	5
35	77	18	5	20	77	14	9
51	72	22	6	< 0	67	13	20
64	67	26	7	61	67	20	13
23	67	20	13	105	67	26	7
< 0	67	18	20	55	72	17	11
< 0	50	10	40	72	72	22	6
< 0	50	20	30	< 0	50	10	40
45	50	30	20	28	50	20	30
61	33	40	27	80	50	30	20
25	16.6	44.5	38.9	112	33	40	27
76	14.3	52.5	33.2	25	19.2	36.5	44.3
98	13.5	55.5	31.0	55	17.3	42.3	40.4
115	12.9	57.2	29.9	86	16.1	46.5	37.4
25	10.6	47.2	42.2	109	14.9	50.3	34.8
45	9.9	50.5	39.6	25	12.0	39.6	48.4
68	9.2	53.5	37.3	55	11.1	44.1	44.8
85	8.7	56.5	34.8	86	10.2	48.6	41.2
102	8.2	59.5	32.3	110	9.5	52.2	38.3
25	5.3	46.8	47.9	25	5.3	47.0	47.7
70	4.7	53.5	41.8	55	5.0	50.0	45.0
90	4.3	56.5	39.2	86	4.6	53.4	42.0
110	4.1	59.0	36.2	107	4.3	56.7	39.0
25	1.7	42.8	55.8	25	1.8	39.7	58.5
56	1.6	47.1	51.3	64	1.7	44.8	53.5
78	1.5	50.7	47.8	84	1.5	50.0	40.5
98	1.4	54.0	44.6	107	1.4	52.4	46.2

Results are also given for the Solubility of Resins A and B in mixtures of Octadecane and Toluene.

Results for equilibrium in the System Styrene-Ethyl Benzene in terms of Mol. % composition of the liquid and vapor phases at temperatures from 56.30 to 78.9° and at residual pressures of 50 mm and 90 mm, are given by Zeidler, Komissarova, and Golubickaja, 1940.

DICHLORO o XYLENE 4, 5 $C_6H_2Cl_2(CH_3)_2$

SOLUBILITY OF 4, 5 DICHLORO o XYLENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $C_8H_8Cl_2$ in Saturated Solution
8.77	0.152
19.92	0.213
29.93	0.305

ACETAPHENONE $CH_3COC_6H_5$

SOLUBILITY OF ACETOPHENONE IN AQUEOUS SOLUTIONS OF SODIUM BENZENE AND OTHER SULFONATES
(Booth and Everson, 1949)

Gms. Sulfonate per 100 cc Aqueous Solvent	cc $CH_3COC_6H_5$ per 100 cc Aqueous Solution of: Na Benzene Sulfonate		Na p Cymene Sulfonate		Na Toluene Sulfonate		Na Xylene Sulfonate	
	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°	At 25°	At 60°
0 (=H_2O)	0.54	0.80	0.54	0.80	0.54	0.80	0.54	0.80
5	0.60	0.83	0.90	1.42	0.63	0.99	0.74	1.07
10	0.80	0.97	2.37	2.64	0.91	1.37	1.40	1.65
20	1.30	1.62	7.33	9.53	2.77	3.40	4.80	5.46
32	2.65	3.56	--	--	--	--	--	--
34.6	--	--	35.7	35.7	--	--	--	--
40	--	--	--	--	15.4	16.0	29.6	31.2

PHENYL ACETIC ACID $C_6H_5CH_2COOH$

The distribution coefficient of Phenyl Acetic Acid between Ethyl Ether and Water, for concentrations of 1068 millimols per liter in the ether layer divided by 28.6 millimols per liter in the water layer is 37 at about 20°. (Collander, 1949).

MANDELIC ACIDS (r) and (l) $C_6H_5CHOHCOOH$

SOLUBILITY OF (r) and (l) MANDELIC ACID, EACH SEPARATELY, IN WATER
(Angus and Owen, 1943)

Results for:

(r) Mandelic Acid				(l) Mandelic Acid			
t°	Gms. $C_8H_8O_3$ per 100 gms. H_2O	t°	Gms. $C_8H_8O_3$ per 100 gms. H_2O	t°	Gms. $C_8H_8O_3$ per 100 gms. H_2O	t°	Gms. $C_8H_8O_3$ per 100 gms. H_2O
0	8.79	37	20.94	24.5	8.9	48.5	74.0
10	11.68	40	163.2	27.5	10.9	50.5	94.4
15	13.40	42.5	192.4	31.5	14.3	52.5	112.8
20	16.19	45	247.0	37.0	20.8	54.5	129.1
25	21.95	47	274.2	41.5	30.0	57.0	155.1
30	37.46	50	373.0	44.0	39.8	60.5	194.0
35	81.8			46.5	55.7	68.0	289.2

SOLUBILITY OF O-ACYL (r) MANDELIC ACIDS, EACH SEPARATELY, IN WATER
(Angus and Owen, 1943)

t°	Gms. per 100 gms. H_2O			t°	Gms. per 100 gms. H_2O		
	Acetyl (r) Mandelic Acid	Propionyl (r) Mandelic Acid	Benzoyl (r) Mandelic Acid		Acetyl (r) Mandelic Acid	Propionyl (r) Mandelic Acid	Benzoyl (r) Mandelic Acid
0	0.57	0.29	0.51	30	1.39	0.59	0.92
10	0.68	0.35	0.60	35	1.99	0.74	1.04
15	0.76	0.37	0.65	40	3.18	1.22	1.27
20	0.96	0.38	0.73	45	5.74	1.85	1.57
25	1.14	0.52	0.79	50	13.50	3.46	1.88

The distribution coefficient of Mandelic Acid between Ethyl Ether and Water, for concentrations of 74.0 to 745 millimols per liter of the ether layer divided by 33.2 to 231 millimols per liter of the water layer is 2.2 - 3.2 at about 20°. (Collander, 1949).

Freezing-point data for mixtures of the racemic and laevo forms of Mandelic Acid, and of the Acetyl, Propionyl, Methyl, Ethyl and Isobutyl derivatives of (r) and (l) Mandelic Acid, are given by Angus and Owen, 1943 (a).

VANILLIN $CH_3O(OH)C_6H_3CHO$

The distribution of Vanillin between Ethyl Ether and Water $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ is 9.3 at about 20°. (Collander, 1949, quoted from the I.C.T.).

ACETANILIDE $CH_3CONHC_6H_5$

SOLUBILITY OF ACETANILIDE IN WATER
(Logan, 1945)

t°	Gms. $CH_3CONHC_6H_5$ per 100 gms. Sat. Sol.	t°	Gms. $CH_3CONHC_6H_5$ per 100 gms. Sat. Sol.
0	0.3598	40	0.9737
10.13	0.4414	50	1.326
20.	0.5612	60	1.857
25	0.6390	70	2.676
30	0.7285		

These results differ somewhat from the previous determinations of School and Weerd, 1922.

Results for the solubility of Acetanilide in aqueous solutions of KCl, NaCl and Na_2SO_4, at temperatures from 0° to 60°, in terms of k, the salting out effect, are given by Logan, 1946.

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Acetanilide between Ethyl Ether and Water, is 3.0 at 25°. (Collander, 1949, quoted from the I.C.T)

Freezing-point data for mixtures of Acetanilide and Azobenzene, in the form of a diagram, are given by Kofler, 1949.

NITRO PHENETOLE $NO_2C_6H_4OC_2H_5$

Freezing-point data for mixtures of p Nitro Phenetole and Dimethyl Amine are given by Nelson and Smith, 1942.

ETHYL BENZENE $C_6H_5(C_2H_5)$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF ETHYL BENZENE AND SEVERAL OTHER SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Ethanolamine	150	Triethylene Glycol	115
Diethylene Glycol	155	Ethylene Diformate	46
Resorcinol	151.5	Nitromethane	< -31

Freezing-point data are given for:

Ethyl Benzene + Benzene (Kravchenko, 1949)
Ethyl Benzene + Methyl Benzene " "
Ethyl Benzene + Naphthalene " "
Ethyl Benzene + o Xylene + m Xylene + p Xylene (Kravchenko, 1945)

XYLENES o, m, p $C_6H_4(CH_3)_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF m XYLENE AND SEVERAL OTHER SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetamide	200	Benzidine	111
Diethylene Glycol	162	Ethylene Diformate	44
Resorcinol	148.7	Maleic Anhydride	< 15
p Phenylene Diamine	< 130	Ammonia	15
Lactic Acid	124	Methanol	< -78
Triethylene Glycol	120	Furfural	-58

THE EUTECTIC POINTS IN THE TERNARY SYSTEM o, m and p XYLENES
(Pitzer and Scott, 1948)

t°	Gms. per 100 gms. Mixture		
	o Xylene	m Xylene	p Xylene
220.3	-	87.0	13.0
237.6	75.7	-	24.3
211.4	66.6	33.4	-
209.0	30.5	61.4	8.10

Freezing-point data are given by Kravchenko, 1949 for:

o Xylene + Naphthalene
p Xylene + Naphthalene
p Xylene + Toluene
p Xylene + Benzene

β PHENYL ETHYL ALCOHOL (2-Phenylethanol) $C_6H_5CH_2CH_2OH$

RECIPROCAL SOLUBILITY OF β PHENYL ETHYL ALCOHOL AND WATER
(Hückel, Niesel, and Büchs, 1944)

t°	Gms. $C_6H_5CH_2CH_2OH$ per 100 gms. H_2O Rich Layer	Gms. $C_6H_5CH_2CH_2OH$ per 100 gms. Alcohol Rich Layer	t°	Gms. $C_6H_5CH_2CH_2OH$ per 100 gms. H_2O Rich Layer	Gms. $C_6H_5CH_2CH_2OH$ per 100 gms. Alcohol Rich Layer
25	1.78	92.80	45	1.92	90.78
30	1.81	92.33	50	1.945	90.44
35	1.85	91.86	55	1.99	89.72
40	1.89	91.37			

CAFFEINE $C_8H_{10}O_2N_4$

SOLUBILITY OF CAFFEINE IN AQUEOUS SOLUTIONS OF SODIUM SALICYLATE AT 20°
(Krasnec, 1948)

d of Saturated Solution	Gms. HOC_6H_4COONa per 100 gms. Solvent	Gms. $C_8H_{10}O_2N_4$ per 100 gms. Sat. Sol.
1.01094	1.0	4.596
1.02475	2.5	7.435
1.05110	5.0	10.75
1.09454	10.0	16.59
1.12076	15.0	20.74
1.15192	20	23.98
1.17872	25	26.48
1.20260	30	27.98
1.22728	35	29.29

Results are also given for the viscosities of the solutions.

SOLUBILITY OF CAFFEINE IN AQUEOUS SOLUTION OF HYDROCHLORIC ACID AT 20°
(Krasnec, 1948)

Gm. Mols. HCl per liter	Gms. $C_8H_{10}O_2N_4$ per 100 cc Sat. Sol.	Gm. Mols. HCl per liter	Gms. $C_8H_{10}O_2N_4$ per 100 cc Sat. Sol.
0.05	1.99	0.3	2.394
0.10	2.066	0.4	2.549
0.20	2.246	0.5	2.695

SOLUBILITY OF CAFFEINE IN 0.5 MOLECULAR AQUEOUS SOLUTIONS OF SEVERAL AMINE HYDROCHLORIDES AT 20°
(Krasnec, 1948)

Amine Hydrochloride	Gms. $C_8H_{10}O_2N_4$ per 100 cc Sat. Sol.
Aniline Hydrochloride	3.608
o Toluidine Hydrochloride	4.683
p Toluidine Hydrochloride	4.809
p Amino Acetophenone·HCl	8.049
Anaesthesin Hydrochloride*	8.115
Novocaine Hydrochloride	12.27

* 0.2351 mol. instead of 0.5 mol.

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Caffeine between Ethyl Ether and Water is 0.04 - 0.06 at 25°. (Collander, 1949, quoted from Pinnow, 1916).

DIMETHYL ANILINE $C_6H_5(CH_3)_2N$

FREEZING-POINT DATA FOR MIXTURES OF DIMETHYL ANILINE AND SULFUR DIOXIDE
(Bright and Fernelius, 1948)

t°	Mol. Fraction $C_6H_5(CH_3)_2N$ in Mixture	Solid Phase	t°	Mol. Fraction $C_6H_5(CH_3)_2N$ in Mixture	Solid Phase
-75.0	0.0	SO_2	12.6(m.pt)	0.587	1:1
-81.1	0.133	"	11.5	0.649	"
-85.1	0.161	"	10.9	0.669	"
-90.1 (Eut.)	0.178	SO_2 + 1:1	5.3	0.749	"
-72.5	0.198	1:1	2.3	0.781	"
-44.6	0.248	"	-4.5	0.838	"
-30.1	0.274	"	-6.8(Eut.)	0.857	1:1 + $C_6H_5(CH_3)_2N$
-17.1	0.314	"	-3.8	0.885	$C_6H_5(CH_3)_2N$
-1.1	0.376	"	-0.5	0.918	"
+7.1	0.424	"	+2.0	1.000	"

1:1 = $C_6H_5(CH_3)_2N \cdot SO_2$

Results are also given for the freezing-points of mixtures of $C_6H_5(CH_3)_2N \cdot SO_2$ and $C_6H_5(CH_3)_2N$

SUBERIC ACID $(CH_2)_6(COOH)_2$

DISTRIBUTION OF SUBERIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration in the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.10%) divided by the concentration in the organic solvent layer.

Organic Solvent in Contact with H_2O	Dist. Coef K $\frac{\text{conc. in } H_2O}{\text{conc. in org. solvent}}$	Organic Solvent in Contact with H_2O	Dist. Coef. K $\frac{\text{conc. in } H_2O}{\text{conc. in org. solvent}}$
n Butanol	0.12	Diiso Propyl Ketone	0.53
Ethyl Acetate	0.16 - 0.20	Butyl Acetate	0.38
Ethyl Ether	0.34 - 0.36	Methyl Isobutyl Ketone	0.21
Chloroform	10 +	Methyl Propyl Ketone	0.12
Skellysolve B	10 +	Methyl Ethyl Ketone	0.21
Carbon Tetrachloride	10 +	Cyclohexanone	0.14
Benzene	10 +		

The distribution of Suberic Acid between Ethyl Ether and Water ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) for concentrations of 0.49 to 9.86 millimols per liter in the water layer is 3.6 to 4.7 at 25°. (Collander, 1949, quoted from Chandler, 1908).

Freezing-point data are given by Houston and Van Sandt, 1946 for MIXTURES of Suberic Acid with Azelaic, Sebacic and Adipic Acids.

DIETHYL TARTRATE $C_8H_{14}O_6$

The distribution coefficient of Diethyl Tartrate between Ethyl Ether and Water, for concentrations of 704 millimols per liter in the ether layer divided by 1087 millimols per liter in the water layer is 0.65 at 18°. (Collander, 1949).

TROPINE $C_8H_{15}ON$

The distribution coefficient of Tropine between Ethyl Ether and Water, for concentrations of 4.7 millimols per liter in the ether layer divided by 88 millimols per liter in the water layer, is 0.053 at 15°. (Collander, 1949).

DIISOBUTENE $(CH_3)_3C{\cdot}CH\ C(CH_3)_2 + (CH_3)_3C{\cdot}CH_2\ C(CH_3){:}CH_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIISOBUTENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetic Acid	-37	Ethyl Lactate	-30
Acetic Anhydride	27	Ethyl Oxalate	-30
Chloro Acetic Acid	67	Methyl Furoate	14
Benzoic Anhydride	20	Ethyl Furoate	-30
Phthalic Anhydride	126	n propyl Furoate	-70
Anthranilic Acid	150	n Butyl Furoate	-66
Methanol	0	n Amyl Furoate	-82
Diacetone Alcohol	-48	Methyl Anthranilate	3
Methyl Cellosolve	-2	Ammonia	46
Methyl Carbitol	55	Carbon Dioxide	< -78
Carbitol	-25	Sulfur Dioxide	-35
Ethylene Chlorohydrin	72	Acetone	-67
Furfural Alcohol	79	Acetonyl Acetone	31
Tetrahydro Furfural Alcohol	45	Acetophenone	-28
Benzyl Alcohol	15	Nitro Benzene	-25
Phenyl Ethanol	-14	o Nitro Toluene	-46
Cinnamyl Alcohol	60	o Nitro Phenol	-3
Croton Aldehyde	-70	o Nitro Chloro Benzene	-4
Dicroton	-56	p Nitro Benzyl Chloride	55
Aldol	-27	2-Nitro-4-Methyl Phenol	-22
Furfural	62	m Dinitro Benzene	115
Benzaldehyde	-38	2, 4-Dinitro Chloro Benzene	128
Salicyl Aldehyde	-7	Phenol	0
Aniline	36	o Cresol	-45
o Toluidine	-10	m Cresol	-39
Xilidines	-67	p Cresol	-40
α Naphthylamine	74	Cresylic Acid	-45
β Naphthylamine	88	o Chloro Phenol	-43
o Amino Diphenyl	3	p Chloro Phenol	6
p Amino Diphenyl	82	o Benzyl Phenol	14
Diphenyl Ethylene Diamine	62	Eugenol	-42
Phenyl α Naphthylamine	17	m Hydroxy Diphenyl	67
o Chloro Aniline	-27	β Naphthol	73
o Nitro Aniline	151	Acetanilide	145
3, 4 Nitro Amino Toluene	118	n Butyramide	128
o Phenetidine	-9	Chlorex	-19
p Phenetidine	48	α Naphthonitrile	26
Ethyl Formate	-82	β Naphthonitrile	29
Ethyl Aceto Acetate	-2	Pyridine	-54

CAPRYLIC ACID (Octanoic Acid) $CH_3(CH_2)_6COOH$

SOLUBILITY OF CAPRYLIC ACID IN WATER

(Ralston and Hoerr, 1942; Eggenberger, Broome, Ralston, and Harwood, 1949)

t°	Gms. $C_8H_{16}O_2$ per 100 cc Sat. Sol.	Gms. $C_8H_{16}O_2$ per 100 gms. H_2O	t°	Gms. $C_8H_{16}O_2$ per 100 cc Sat. Sol.	Gms. $C_8H_{16}O_2$ per 100 gms. H_2O
0	-	0.044	45	-	0.095
15	-	0.079*	50	0.0943	-
20	-	0.068	60	0.1071	0.113
30	0.0789	0.079	100	-	0.25*
40	0.0843	-			

*Lewkowitch, Chem., Tech. and Anal. of Oils, Fats and Waxes, 6th. Ed. Vol. 1, 1921.

SOLUBILITY OF CAPRYLIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_6COOH$ per 100 gms. Solvent in:		
	95 Wt. % C_2H_5OH	$(CH_3)_2CO$	C_6H_6
0	262	221	-
10	1035	975	770
20	∞	∞	∞
30	-	-	-

SOLUBILITY OF CAPRYLIC ACID IN SEVERAL SOLVENTS

(Hoerr, Sedgwick, and Ralston, 1946)

t°	Gms. $CH_3(CH_2)_6COOH$ per 100 gms. Solvent in:					
	Toluene	o Xylene	Chloro Benzene	Nitro Benzene	Furfural	1, 2 Dichloro Ethane
-10	69.5	57.0	73.6	-	-	-
0	168.0	154.0	178.0	-	22.5	144.0
10	605.0	562.0	725.0	365	216.0	630.0
20	∞	∞	∞	∞	∞	∞

SOLUBILITY OF CAPRYLIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_6COOH$ per 100 gms. Solvent in:				
	Cyclo Hexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	115	213	161	206
10	670	370	720	610	700
20	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_6COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Methane	Acetonitrile
0	330	280	225	25.2	44.5
10	1300	900	750	790.0	1020.
20	∞		∞	∞	∞

THE EUTECTICS OF MIXTURES OF CAPRYLIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_6COOH$
Caprylic Acid + Benzene	-10.5	50.4
Caprylic Acid + Cyclohexane	-14.0	22.0
Caprylic Acid + Glacial Acetic Acid	+ 3.1	80.0

CAPRYLAMIDE (Octanamide) $CH_3(CH_2)_6CONH_2$

SOLUBILITY OF CAPRYLAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_6CONH_2$ per 100 gms. Solvent in:

t°	Methanol	95% Ethanol	Isopropanol	n Butanol	Acetone	2-Butanone
10	22.1	13.4	15.7	17.1	3.4	3.4
30	53.0	32.8	26.3	25.8	7.8	8.3
50	130.0	76.0	66.0	51.0	31.4	27.9
60	206.0	120.0	102.0	-	48.4 (56.5°)	50.8
70	263 (64.7°)	193.0	157.0	132.0	-	89.0
80	-	303.0 (78.5°)	288. (82.3°)	-	-	163.0 (79.6°)
90	-	-	-	420.0	-	-
100	-	-	-	1300.0	-	-

Gms. $CH_3(CH_2)_6CONH_2$ per 100 gms. Solvent in:

t°	Ethyl Acetate	Butyl Acetate	Nitro Methane	Tetrachloro Methane	Aceto-nitrile	Benzene	Cyclo-hexane
10	2.2	2.6	1.0	-	1.1	0.5	-
30	5.7	6.0	2.1	0.4	5.4	0.6	0.1
50	18.9	17.0.	7.5	0.7	16.4	4.1	0.2
60	35.4	-	-	3.7	31.6	13.8	0.3
70	69.0	48.1	37.5	18.2	73.0	52.0	1.2
80	115.0 (77.2°)	-	-	42.5 (76.°)	200.0 (82°)	153.0 (80.1°)	53.0 (81.4°)
90	-	205.0	307.0	-	-	-	-
100	-	740.0	1600.0	-	-	-	-

ISO OCTANE (2, 2, 4-Trimethyl Pentane) $CH_3C(CH_3)_2CH_2CH(CH_3)CH_3$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF ISO OCTANE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Acetic Acid	6.5	Ethyl Lactate	19
Acetic Anhydride	66.	Ethyl Oxalate	21
Chloro Acetic Acid	139	Butyl Oxalate	-58
Furoic Acid	184	Methyl Furoate	61
Benzoic Anhydride	91	Ethyl Furoate	20
Phthalic Anhydride	193	n Propyl Furoate	-20
Anthranilic Acid	219	n Butyl Furoate	-18
Methanol	43	n Amyl Furoate	-28
Ethanol	-70	Methyl Anthranilate	38
Diacetone Alcohol	4	Phenyl Phthalate	145
Methyl Cellosolve	46	Triphenyl Phosphite	111
Cellosolve	-15	Ammonia	61
Methyl Carbitol	104	Carbon Dioxide	-61
Carbitol	28	Sulfur Dioxide	18.7
Ethylene Dichlorohydrin	113	Acetone	-34
Furfuryl Alcohol	122	Acetonyl Acetone	72
Tetrahydro Furfuryl Alcohol	93	Acetophenone	14
Benzyl Alcohol	73	Quinone	116
Phenyl Ethanol	49	Nitro Benzene	27
Cinnamyl Alcohol	115	o Nitro Toluene	8
Croton Aldehyde	-14	o Nitro Phenol	48
Dicroton	-16	o Nitro Chloro Benzene	49
Aldol	37	p Nitro Benzyl Chloride	111
Paraldehyde	-60	2-Nitro-4-Methyl Phenol	25
Furfural	101	2, 4-Dinitro Chloro Benzene	190
Benzaldehyde	16	Phenol	66
Salicyl Aldehyde	42	o Cresol	21
Aniline	80	m Cresol	29.5
o Toluidine	35	p Cresol	28
p Toluidine	< 35	Cresylic Acid	15
Xylidines	-11	o Chloro Phenol	18
Methyl Aniline	9.5	p Chloro Phenol	80
α Naphthylamine	130.	2, 4, Xylen-1-ol	-45
β Naphthylamine	147	o Benzyl Phenol	81
o Amino Diphenyl	60	Eugenol	11
p Amino Diphenyl	140	o Hydroxy Diphenyl	49
Diphenyl Amine	43	m Hydroxy Diphenyl	138
Diphenyl Ethylene Diamine	118	β Naphthol	150
Phenyl α Naphthylamine	84	Acetonitrile	81
o Chloro Aniline	26.5	Acetanilide	221
p Chloro Aniline	86	n Butyramide	184
o Nitro Aniline	222	Chlorex	19
3, 4 Nitro Amino Toluene	190	Dioxane	-7
o Phenetidine	38	α Naphthonitrile	85
p Phenetidine	92	β Naphthonitrile	93
Ethyl Formate	-42	Pyridine	-15
Ethyl Aceto Acetate	43		

OCTANE n $CH_3(CH_2)_6CH_3$

SOLUBILITY OF WATER IN OCTANE
(Black, Joris, and Taylor, 1948)

100 mols n $CH_3(CH_2)_6CH_3$ dissolve 0.09 mols. H_2O at 20°.
100 gms. " " 0.0142 gms. H_2O at 20°.

The determination was made by the use of Tritium Oxide as a tracer.

SOLUBILITY OF n OCTANE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Crews, 1944)

t°	Gms. $CH_3(CH_2)_6CH_3$ per 100 gms. Solvent in:			
	Trichloro Methane	Ethyl Ether	Ethyl Acetate	Butyl Acetate
-75	-	37.5	1.1	8.8
-70	-	68.0	3.2	13.3
-65	-	147.0	7.9	26.4
-60	275	550.0	25.0	120.0
-55	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_6CH_3$ per 100 gms. Solvent in:			
	Acetone	2-Butanone	Isopropanol	n Butanol
-75	1.0	3.0	7.1	12.2
-70	1.7	4.4	9.9	15.4
-65	2.8	8.0	15.9	22.1
-60	5.3	31.2	36.0	45.1
-55	8.0	∞	∞	∞

THE EUTECTICS OF MIXTURES OF OCTANE AND OTHER SOLVENTS
(Ralston, Hoerr, and Crews, 1944)

Mixture	Eutectic Temperature	Wt. % Octane
Octane + Benzene	-58.4	91.8
Octane + Cyclohexane	-71.6	39.1
Octane + Tetrachloro Methane	-66.3	39.1
Octane + Trichloro Methane	-67.8	25.3

The critical solution temperature of mixtures of n Octane and Aniline is 71.8°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

The freezing-points of mixtures of Octane and Decane are given by Kravchenko, 1949.

2 - METHYL HEPTANE $(CH_3)_2CH(CH_2)_4CH_3$

The critical solution temperature of mixtures of 2-Methyl Heptane and Aniline is 74.0°. (Ludeman, 1940, quoted from Evans, 1937).

OCTANOL 1- $CH_3(CH_2)_6CH_2OH$

SOLUBILITY OF 1 - OCTANOL IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF THE HIGHER FATTY ACIDS AT 25° (?)

(Harkins and Oppenheimer, 1949)

Potassium Salt of: (0.3 mol per 1000 gms)	Mols. $C_8H_{18}O$ per 1000 gms. Soap Solution	Potassium Salt of: (0.3 mol per 1000 gms)	Mols. $C_8H_{18}O$ per 1000 gms. Soap Solution
Octylic Acid	0.023	Laurinic Acid	0.146
Nonylic Acid	0.095	Myristinic Acid	0.156
Capric Acid	0.127	Pentadecanoic Acid	0.158
Undecylic Acid	0.148	Na Dodecyl Sulfate	0.171

The saturated solutions were analyzed by turbidity measurement.

TETRA ETHYLENE GLYCOL $C_8H_{18}O_5$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Tetra Ethylene Glycol between Ethyl Ether and Water, for a concentration of about 1000 millimols per liter in the water layer is 0.0024 at about 20°. (Collander, 1949, quoted from Wartiovaarra, 1942).

OCTYLAMINE $CH_3(CH_2)_6CH_2NH_2$

The temperature-composition relations in the system Octylamine-Water are presented by Ralston, Hoerr, and Hoffman, 1942, in the form of a diagram which shows the boundaries of the several liquid and solid phases but from which accurate numerical values cannot be deduced. Two hydrates, having the compositions $(C_8H_{17}NH_2)_2 \cdot 3H_2O$ and $C_8H_{17}NH_2 \cdot 3H_2O$, are formed.

The solubility curves in Ethyl Alcohol, of Amine Hydrochlorides containing from 8 to 18 carbon atoms, are presented by Sedgwick, Hoerr, and Ralston, 1945, without accompanying numerical results. It is shown that only the salts containing even numbers of C atoms crystallize from alcohol in a stable and an unstable form and possess two solubility curves.

DIISO BUTYL AMINE $[(CH_3)_2CHCH_2]_2NH$

The distribution coefficient of Diisobutyl Amine between Ethyl Ether and Water, for concentrations of 113 millimols per liter in the ether layer divided by 0.75 millimols per liter in the water layer is 151 at 18°. (Collander, 1949).

TETRA ETHYL AMMONIUM IODIDE $N(C_2H_5)_4I$

SOLUBILITY OF TETRAETHYL AMMONIUM IODIDE IN MIXTURES OF ETHYLENE DICHLORIDE AND BENZENE AT 25°

(Vernon and Sheard, 1948)

Percent Ethylene Dichloride in Solvent Mixture	Mols. $N(C_2H_5)_4I$ per liter Sat. Solution	Percent Ethylene Dichloride in Solvent Mixture	Mols. $N(C_2H_5)_4I$ per liter Sat. Solution
35.5	0.0000865	80.0	0.001806
48.0	0.000218	85.0	0.00306
56.6	0.000380	93.5	0.00556
68.0	0.000851	100.0	0.00919

TETRA ETHYL AMMONIUM HYDROXIDE $N(C_2H_5)_4OH$

The distribution coefficient of Tetraethyl Ammonium Hydroxide between Ethyl Ether and Water, for concentrations of about 0.0003 millimols per liter in the ether layer divided by 1700 millimols per liter in the water layer is 0.000002 at 19°. (Collander, 1945).

TRIMESIC ACID $C_6H_3(COOH)_3$

The distribution coefficient of Trimesic Acid between Ethyl Ether and Water, for concentrations of 57.7 millimols per liter in the ether layer divided by 5.37 millimols per liter in the water layer is 11 at 20°. (Collander, 1949).

CINNAMIC ACID $C_6H_5CH:CHCOOH$

SOLUBILITY OF CINNAMIC ACID IN FURFURAL

t°	Gms. $C_9H_8O_2$ per 100 gms. Saturated Solution
0	0.6
25	4.1
40	10.9

Freezing-points of mixtures of Cinnamic Acid and Hydro Cinnamic Acid are given by Kofler and Brandstatter, 1943a.

HOMOPHTHALIC ACID $C_6H_4(CH_2COOH)COOH$

The distribution coefficient of Homophthalic Acid between Ethyl Ether and Water, for concentrations of 7.85 - 30.8 millimols per liter in the ether layer divided by 3.95 - 13.8 millimols per liter in the water layer is 2.0 - 2.2 at 25°. (Collander, 1949, quoted from Diechmann and Hardt, 1919).

ACETYL SALICYLIC ACID (Aspirin) $CH_3COOC_6H_4COOH$

SOLUBILITY OF ACETYL SALICYLIC ACID IN MIXTURES OF ETHYL ETHER AND PETROLEUM ETHER AND IN MIXTURES OF ETHYL ALCOHOL AND PETROLEUM ETHER

(Ebach, 1943)

Results for:

$(C_2H_5)_2O$ + Pet. Ether at about 20°

Solvent		Gms. $C_9H_8O_4$ per 100 cc Solvent
cc $(C_2H_5)_2O$	cc Pet. Ether	
100	0	3.13
90	10	2.08
70	30	1.26
50	50	0.62
30	70	0.24
10	90	0.05
0	100	0.00

C_2H_5OH + Pet. Ether at 5°

Solvent		Gms. $C_9H_8O_4$ per 100 cc Solvent
cc (C_2H_5OH)	cc Pet. Ether	
100	0	10.30
90	10	8.73
70	30	5.53
50	50	3.47
30	70	1.92
10	90	0.52
0	100	0.00

TRIMETHYL TRICHLORO BENZENES $C_6(CH_3)_3Cl_3$

SOLUBILITY OF 1, 3, 5 TRIMETHYL, 2, 4, 6 TRICHLORO BENZENE AND 1, 2, 5 TRIMETHYL, 3, 4, 6 TRICHLORO BENZENE, EACH SEPARATELY IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction in Saturated Solutions	
	1, 3, 5 Trimethyl 2, 4, 6 Trichloro Benzene	1, 2, 5 Trimethyl 3, 4, 6 Trichloro Benzene
8.77	0.007	0.0111
19.92	0.0136	0.0147
29.93	0.0190	0.0217
41.88	0.0270	0.0319

HIPPURIC ACID $C_6H_5CONHCH_2COOH$

The distribution coefficient of Hippuric Acid between Ethyl Ether and Water, for concentrations of 9.33 millimols per liter of the ether layer divided by 23.7 millimols per liter of the water layer is 0.39 at 17°. (Collander, 1949).

INDANOLS, 4- and 5- $C_6H_4CH_2CH_2CHOH$

DISTRIBUTION OF INDANOLS BETWEEN WATER AND CYCLOHEXANE AT 25°
(Orchin and Golumbic, 1949)

	Distribution Coefficient K (conc. H_2O ÷ conc. C_6H_{12})
4- Indanol	4.5
5- Indanol	3.7

CUMENE HYDROPEROXIDE $C_6H_5C(CH_2)_2OOH$

SOLUBILITY OF CUMENE HYDROPEROXIDE IN WATER AND ITS DISTRIBUTION BETWEEN WATER AND BENZENE AT 25°
(Kolthoff and Medalia, 1949)

100 cc saturated solution of Cumene Hydroperoxide in water contain 1.39 gms. $C_6H_5C(CH_2)_2OOH$. This corresponds to 0.165 Mol. % and 0.0914 molar concentration.

The distribution of Cumene Hydroperoxide between:

Water and Benzene		Aq. Sodium Hydroxide Solution and Benzene		
Mol. % $C_6H_5C(CH_2)OOH$ in:		Normality of Aq. NaOH	Mol. % $C_6H_5C(CH_2)_2OOH$ in:	
H_2O Phase	C_6H_6 Phase		Aq. NaOH Phase	C_6H_6 Phase
0.0282	6.67	0.0506	0.0551	6.70
0.0522	17.6	0.253	0.132	5.51
0.0865	36.3			

ACETYL p TOLUIDINE (p Acetotoluide) $CH_3CONHC_6H_4CH_3$

SOLUBILITY OF ACETYL p TOLUIDINE IN SEVERAL SOLVENTS
(Pollock, Collett, and Lazell, 1946)

t°	Mols. $CH_3CONHC_6H_4CH_3$ per 100 mols. Saturated Solution in: Methanol	Ethanol	1-Propanol	2-Propanol	1-Butanol	Isobutyl Alcohol
30	3.2	4.0	4.7	3.6	4.0	4.5
40	5.1	5.5	5.8	5.0	5.5	5.5
50	7.5	7.6	7.7	7.0	7.6	7.1
60	10.9	10.3	10.6	9.5	10.6	9.7
70	15.1	13.7	14.7	13.5	14.8	13.4
80	20.5	18.8	20.5	18.7	20.3	18.7
90	27.7	25.6	27.3	25.0	27.0	25.5
100	36.2	33.7	35.5	33.0	35.5	34.2
110	45.0	41.5	45.4	43.1	46.0	45.0
120	55.02	54.0	56.6	55.4	57.3	57.0
130	68.0	67.5	69.0	70.0	70.0	70.0
140	83.0	83.0	83.0	83.0	84.0	84.0

t°	Mols. $CH_3CONHC_6H_4CH_3$ per 100 mols. Saturated Solution in: tert. Butyl Alcohol	Benzene	Chloroform	Carbon Tetra-Chloride	Ethyl Ether	Water
30	0.8	0.4	1.3	0.2	-	-
40	1.4	0.4	4.2	0.3	0.7	-
50	2.6	0.5	8.3	0.4	0.9	-
60	6.0	0.7	12.9	0.4	1.2	-
70	10.7	2.6	18.3	0.6	1.4	-
80	16.6	5.0	24.6	1.2	1.9	-
90	23.6	11.7	31.7	3.7	3.7	-
100	31.7	24.4	39.1	13.0	8.4	-
110	41.4	36.3	48.1	32.2	18.3	*
120	53.1	48.7	57.7	47.7	33.0	49.0
130	66.7	64.5	69.0	64.5	55.6	67.4
140	83.0	83.0	83.0	83.0	83.0	85.0

*Very insoluble at low temperatures; forms two liquid layers at 117.6°.

Freezing-points of mixtures of m Aceto Toluide and Acenaphthene are given by Kofler, 1949.

PHENYL ALANINE $C_6H_5CH_2CHNH_2COOH$

100 cc Butyric Acid dissolve 0.075 gm. $C_9H_{11}O_2$ at 18°. (Przylecki and Kasprzyle-Czaykowska, 1938).

(1) TYROSINE $HOC_6H_4CH_2CH(NH_2)COOH$

One liter saturated solution of (1) Tyrosine in Water contain 0.0025 Gm. Mols. $C_9H_{11}O_3$ at 25°. (Zachary and Moore, 1949)

SOLUBILITY OF (1) TYROSINE IN LIQUID AMMONIA
(Zachary and Moore, 1949)

t°		Mols. $C_9H_{11}O_3$ per liter Saturated Solution
°K	°C	
196	-77	0.0021
210	-63	0.0031
227.5	-45.5	0.0118
238	-35	0.0220

METHYL ETHYL BENZENE $C_6H_4CH_3(C_2H_5)$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF METHYL ETHYL BENZENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	176	Ethylene Diformate	66
p Phenylene Diamine	150	Maleic Anhydride	31
Triethylene Glycol	138	Nitro Methane	-25
Benzidine	127	Methanol	-78

CUMENE $C_6H_5CH(CH_3)_2$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF CUMENE AND SEVERAL SOLVENTS
(Francis, 1944

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Adipic Acid	198	Ammonia	25
Diethylene Glycol	178	Methyl Sulfate	< -50
p Phenylene Diamine	153	m Dinitro Benzene	< 68
Triethylene Glycol	137	Nitro Methane	-28
Benzidine	139	Furfural Alcohol	-50
Ethylene Diformate	68	Acetonitrile	< -78
Maleic Anhydride	55		

PSEUDO CUMENE 1, 2, 4 $(CH_3)_3C_6H_3$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF PSEUDO CUMENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	187	Methyl Sulfate	3
Triethylene Glycol	152	Nitro Methane	1
Benzidine	149	Methanol	-26
Ethylene Diformate	82	Furfural Alcohol	-11
Maleic Anhydride	70		

TRIACETIN (Glycerol Triacetate) $C_3H_5(OOCCH_3)_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Triacetin between Ethyl Ether and Water, for a concentration of about 100 millimols per liter of the water layer is 1.4 at 18°. (Collander, 1949).

TRIMETHYL CITRATE $C_3H_4(OH)(COOCH_3)_3$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Trimethyl Citrate between Ethyl Ether and Water, for a concentration of about 100 millimols per liter of the water layer is 0.43 at 22°. (Collander, 1949, quoted from Bärlund, 1929).

AZELAIC ACID $(CH_2)_7(COOH)_2$

DISTRIBUTION OF AZELAIC ACID BETWEEN WATER AND ORGANIC SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26°, and calculating the concentration in the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.1%) divided by the concentration in the organic solvents.

Results for K in:

$\frac{H_2O}{\text{n Butanol}}$	$\frac{H_2O}{\text{Ethyl Acetate}}$	$\frac{H_2O}{\text{Ethyl Ether}}$	$\frac{H_2O}{\text{Chloroform}}$	$\frac{H_2O}{\text{Skellysolve B}}$
< 0.1	< 0.1	0.11-0.14	3.8-4.6	10+

NONYLIC ACID (Pelargonic Acid) $CH_3(CH_2)_7COOH$

SOLUBILITY OF NONYLIC ACID IN WATER

(Ralston and Hoerr, 1942; Eggenberger, Broome, Ralston and Harwood, 1949)

t°	Gms. $CH_3(CH_2)_7COOH$ per: 100 cc Sat. Sol.	100 gms. H_2O	t°	Gms. $CH_3(CH_2)_7COOH$ per: 100 cc Sat. Sol.	100 gms. H_2O
0	-	0.014	45	-	0.041
20	-	0.026	50	0.0264	-
30	0.0212	0.032	60	0.0299	0.051
40	0.0222	-			

SOLUBILITY OF NONYLIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_7COOH$ per 100 gms. Solvent in: 95% C_2H_5OH	$(CH_3)_2CO$	C_6H_6
0	393	356	-
10	3230	3740	2680
20	∞	∞	∞

SOLUBILITY OF NONYLIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_7COOH$ per 100 gms. Solvent in: Cyclohexane	Tetrachloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	158	336	250	316
10	2340	1150	2340	2020	2340
20	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_7COOH$ per 100 gms. Solvent in: Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	510	422	355	45.0	51
10	4650	2920	2530	2340	3470
20	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF NONYLIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; and Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_7COOH$
Nonylic Acid + Cyclohexane	-17.5	23.9
Nonylic Acid + Benzene	-13.0	54.0
Nonylic Acid + Glacial Acetic Acid	+1.6	83.6

TRIMETHYL HEXANOIC ACID (Caproic Acid) 3,5,5 $C_9H_{18}O_2$

SOLUBILITY OF TRIMETHYL HEXANOIC ACID IN AQUEOUS SOLUTIONS OF 3,5,5 TRIMETHYL HEXYL SODIUM SULFATE AT 25°
(Brunner, 1949)

Wt. % 3,5,5 Trimethyl Hexyl Sodium Sulfate in Aqueous Solvent	Gms. 3,5,5 $C_9H_{18}O_2$ per 100 gms. Aqueous Solvent
5.0	1.0
10.0	2.0
25.0	4.0

NONANE $CH_3(CH_2)_7CH_3$

The critical solution temperature of mixtures of Nonane and Aniline is 74.4°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

2 - METHYL OCTANE $CH_3(CH_2)_5CH(CH_3)CH_3$

The critical solution temperature of mixtures of 2-Methyl Octane and Aniline is 77.5°. (Ludeman, 1940, quoted from Evans, 1937).

NONANOL 1- $CH_3(CH_2)_7CH_2OH$

SOLUBILITY OF 1-NONANOL IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF HIGHER FATTY ACIDS AT 25° (?)
(Harkins and Oppenheimer, 1949)

Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_9H_{19}OH$ per 1000 gms. Soap Solution	Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_9H_{19}OH$ per 1000 gms. Soap Solution
Octylic Acid	0.004	Laurinic Acid	0.120
Nonylic Acid	0.076	Myristinic Acid	0.132
Capric Acid	0.0965	Penta Decanoic Acid	0.140
Undecylic Acid	0.1165	Na Dodecyl Sulfate	0.144

The saturated solutions were analyzed by turbidity measurement.

TRIMETHYL HEXANOL 3, 5, 5 $CH_3C(CH_3)_2CH_2CH(CH_3)CH_2CH_2OH$

SOLUBILITY OF TRIMETHYL HEXANOL IN AQUEOUS SOLUTIONS OF 3,5,5 TRIMETHYL HEXYL SODIUM SULFATE AT 25°
(Brunner, 1949)

Wt. % 3,5,5 Trimethyl Hexyl Sodium Sulfate in Aqueous Solvent	Gms. 3,5,5 $C_9H_{20}O$ per 100 gms. Aqueous Solvent
5.0	< 1.0
10.0	2.0
25.0	4.0

TETRA ETHYL UREA 3, 5, 5 $CH_3C(CH_3)_2CH_2CH(CH_3)CH_2CH_2OH$

The distribution coefficient of Tetra Ethyl Urea between Ethyl Ether and Water, for concentrations of 282 millimols per liter in the ether layer divided by 25.6 millimols per liter in the water layer is 11 at 18°. (Collander, 1949).

2-AMINO-5-DIETHYL AMINO PENTANE $C_9H_{22}N_2$

The distribution coefficient of 2-Amino-5-Diethyl Amino Pentane between Ethyl Ether and Water, for concentrations of 139 millimols per liter of the ether layer divided by 241 millimols per liter of the water layer is 0.58 at 20°. (Collander, 1949).

FLAVIANATES of Organic Bases (Flavianic Acid, 2, 4-Dinitro Naphthol-7-Sulfonic Acid) $(NO_2)_2C_{10}H_4OH \cdot SO_3H$

SOLUBILITY OF THE FLAVIANATES OF ORGANIC BASES IN WATER, ETHANOL AND n BUTANOL

(Langley and Noonan, 1942)

Base Flavianates of:	Gms. Flavianate per 1000 cc Saturated Solution in:					
	Water		95% Ethanol		n Butanol	
	At 3°	At 30°	At 3°	At 30°	At 3°	At 30°
Acetyl Choline	-	-	-	-	0.09	0.40
Ammonium	14.2	-	2.57	6.22	0.29	0.39
Choline	-	-	2.81	-	0.17	0.26
Creatinine	2.65	4.54	1.08	1.52	0.09	0.43
as Dimethyl Guanidine	1.85	-	1.30	3.2	0.21	0.30
Ethanol Amine	-	-	2.45	6.8	0.14	0.28
Guanidine	1.30	3.34	1.64	3.57	0.19	0.19
Hydroxyl Amine	16.0	70.0	-	26.0	2.4	5.2
Hypoxanthine	1.3	3.6	0.95	3.36	0.34	0.4
Methyl Amine	7.6	-	1.95	4.10	0.09	0.17
Methyl Guanidine	2.53	5.7	2.6	4.7	0.33	0.35
Methyl Urea	-	-	-	36.0	0.66	1.4
Piperidine	4.0	-	3.3	1.3	0.13	0.35
Potassium	3.7	11.2	0.12	0.16	0.04	0.05
Putrescine	0.25	-	0.31	0.46	-	0.06
Tetra Methyl Ammonium	4.9	12.8	0.61	1.52	0.04	0.05
Trimethyl Amine	47.0	-	4.4	7.27	0.12	0.41
Tryamine	-	-	4.40	10.3	0.34	0.8
Urea	15.7	40.0	12.4	17.0	0.56	0.81

NAPHTHALENE SULFONIC ACID $C_{10}H_7SO_3H$

The distribution coefficient of Naphthalene Sulfonic Acid between Ethyl Ether and Water, for concentrations of 3.1 millimols per liter of the ether layer divided by 608 millimols per liter in the water layer is 0.0051 at 20°. (Collander, 1949).

NAPHTHALENE 1-NITRO $C_{10}H_7NO_2$

Freezing-points of mixtures of 1-Nitro Naphthalene and Diphenyl Amine are given by Nelson and Smith, 1942.

NAPHTHALENE $C_{10}H_8$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF NAPHTHALENE AND VARIOUS SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Glycerol	> 250	Glycerol Monochloro Hydrine	132
Formamide	> 230	Ethanol Amine	97
Ethylene Glycol	195	Diethylene Glycol	84
Triethanol Amine	151	Monoacetin	78
Diethanol Amine	161	Resorcinol	98
Acetamide	148.5	Propylene Glycol	100
p Amino Acetamide	< 140		

Pressure composition data for the solubility of Naphthalene in supercritical Ethylene at 12°, 25°, and 35° are given by Diepen and Scheffer, 1948.

Freezing-point data for all possible binary mixtures of α and β Naphthalene, Naphthol and Naphthylamine are given by Kofler and Brandstatter, 1943b.

Freezing-point data are given for:

Naphthalene + Palmitin (Efremov, Vinogradova, and Tichomirova, 1937)
Naphthalene + 2-Methyl Naphthalene (Cullinane and Chard , 1948)
Naphthalene + Phenanthrene (Klochlso-Zhovnir, 1949)
Naphthalene + Phenanthrene + Acenaphthene (Klochko-Zhovnir, 1949a)

NITRO NAPHTHYL AMINES $(NO_2)C_{10}H_6NH_2$

Freezing-points are given by Hodgson and Hathway, 1944 for mixtures of 4-Nitro-2 Naphthylamine and 3-Nitro-1-Naphthylamine.

NAPHTHYLAMINE 2-$C_{10}H_7NH_2$

SOLUBILITY OF 2-NAPHTHYLAMINE AND OTHER CARCENOGENIC AMINES, EACH SEPARATELY, IN WATER AND IN AQUEOUS CAFFEINE SOLUTIONS

(Neish, 1948)

The solutions were shaken frequently at 37° for five hours and allowed to stand at room temperature one hour before filtering. The amine content of the clear solution was determined by a colorimetric diazotization procedure.

Conc. of Aq. Caffeine in gms. per 100 cc	Solubility of Amines in Milligrams per liter					
	2 Naphthyl-Amine	2-Amino Fluorene	4 Amino Azobenzene	2-Anthr - Amine	4-Amino Stibene	Benzidine
0.0($2H_2O$)	0.189	0.031	0.037	-	0.005	0.270
0.01	0.209	0.035	0.039	-	-	-
0.05	0.248	-	0.053	-	-	-
0.10	0.252	0.089	0.056	-	0.004	0.430
0.15	0.286	0.093	0.075	-	-	-
0.25	0.345	0.140	0.081	-	0.007	0.580
0.30	-	-	-	0.008	-	-
0.35	0.352	0.163	0.087	-	-	-
0.40	-	-	-	0.017	-	-
0.50	0.387	0.193	0.098	0.032	0.012	0.650
0.75	-	-	-	0.042	0.019	1.060
1.00	-	0.279	-	0.055	0.029	1.250

β INDOLYL ACETIC ACID $C_{10}H_{10}O_2N$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of β Indolyl Acetic Acid between Ethyl Ether and Water, is 20 at 20°. (Collander, 1949, quoted from Sutter, 1944).

BENZYL MALONIC ACID $C_{10}H_{10}O_4$

The distribution coefficient of Benzyl Malonic Acid between Ethyl Ether and Water, for a concentration of 110 millimols per liter in the ether layer divided by 7.2 millimols per liter in the water layer is 15 at about 20°. (Collander, 1949).

DIMETHYL PHTHALATE $C_6H_4(COOCH_3)_2$

SOLUBILITY OF DIMETHYL PHTHALATE AND OTHER PLASTICISERS IN WATER

(Haward, 1943)

The determinations were made by a method of scum titration. Plasticiser is added drop by drop from a buret, to 100 - 150 cc of water in a 20 cm. diameter flat dish, until a stable scum of oily drops is obtained.

Plasticiser	Gms. Plasticiser per 100 gms. Sat. Sol. in H_2O	Plasticiser	Gms. Plasticiser per 100 gms. Sat. Sol. in H_2O
Dimethyl Phthalate	0.40	Tributyl Citrate	0.006
Diethyl Phthalate	0.06	Benzyl Benzoate	0.0026
Dibutyl Phthalate	0.0011	Benzyl Glycol Phthalate	0.002
Methyl Phthalyl Ethyl Glycollate	0.11	Butyl Phthalyl Butyl Glycollate	0.001
Ethyl Phthalyl Ethyl Glycollate	0.05	Dimethyl Cyclohexanol Oxalate (Barkite B)	< 0.0002
Methyl Glycol Phthalate	0.88		

Correction to Vol. 2, 3rd. Ed. of Solubilities, p. 667, second line, change critical solution temperature to demixing temperature.

TETRALIN (1, 2, 3, 4 Tetrahydro Naphthalene) $C_{10}H_{12}$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF TETRALIN AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Ethylene Glycol	213	Resorcinol	94
Triethanol Amine	187	Triethylene Glycol	92
Diethanol Amine	181	Ethylene Diformate	42
Ethanol Amine	139	Nitro Methane	-16
Diethylene Glycol	132		

TETRAMETHYL DICHLORO BENZENE 1, 2, 3, 4 $(CH_3)_4C_6Cl_2$, 5, 6

SOLUBILITY OF 1, 2, 3, 4 TETRAMETHYL, 5, 6 DICHLORO BENZENE IN BENZENE

(Smyth and Lewis, 1940)

t°	Mol. Fraction $(CH_3)_4C_6Cl_2$ in Saturated Solution
8.77	0.0188
19.92	0.0253
29.93	0.0370
41.88	0.0475

HYDROXY TETRAHYDRO NAPHTHALENES $C_{10}H_{12}O$

THE DISTRIBUTION COEFFICIENTS OF HYDROXY TETRAHYDRO NAPHTHALENES BETWEEN WATER AND CYCLOHEXANE AT 25°

(Orchin and Golumbic, 1949)

Compound	Distribution Coefficient conc. H_2O ÷ conc. C_6H_{12}
5 - Hydroxy, 1, 2, 3, 4 Tetrahydro Naphthalene	25.3
6 - Hydroxy, 1, 2, 3, 4 Tetrahydro Naphthalene	8.6

DIETHYL BENZENE $C_6H_4(C_2H_5)_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIETHYL BENZENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	193	Methyl Sulfate	-13
p Phenylene Diamine	169	Nitro Methane	-4
Triethylene Glycol	160	Methanol	-18
Benzidine	148	Furfural Alcohol	-16
p Nitro Aniline	139	Acetonitrile	-60
Ethylene Diformate	89	Acetic Anhydride	-50
Maleic Anhydride	73		

sec BUTYL BENZENE $C_6H_5C_2H_5CH(CH_3)$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF sec. BUTYL BENZENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
p Amino Acetamide	210	Methyl Sulfate	-22
Diethylene Glycol	191	Phenyl Ethanol Amine	< -10
p Phenylene Diamine	169	Nitro Methane	0
Triethylene Glycol	156	Furfural Alcohol	-22
Benzidine	158	Acetonitrile	-50
p Nitro Aniline	139	Acetic Anhydride	< -78
Ethylene Diformate	91	Ethylene Diacetate	< -78
Maleic Anhydride	87		

tert BUTYL BENZENE $C_6H_5(CH_3)_3C$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF tert. BUTYL BENZENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	189	Methyl Sulfate	-45
Triethylene Glycol	153	Nitro Methane	-19
Ethylene Diformate	83	Furfural Alcohol	-32
Maleic Anhydride	70		

DICHLORO CAMPHENE 2, 6 $C_{10}H_{14}Cl_2$

Freezing-points (M. pts.) for mixtures of 2, 6 Dichloro Camphene and 2, 6 Dibromo Camphene are given by Pirsch, 1944.

CYMENE $C_{10}H_{14}$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF CYMENE AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	194	Ammonia	25
p Phenylene Diamine	170	Methyl Sulfate	-17
Triethylene Glycol	161	Nitro Methane	-8
Benzidine	157	Methanol	-33
p Nitro Aniline	139	Furfural Alcohol	-19
Ethylene Diformate	89	Acetonitrile	-60
Maleic Anhydride	73	Acetic Anhydride	-50

NICOTINE $C_{10}H_{14}N_2$

DISTRIBUTION OF NICOTINE BETWEEN WATER AND OILS AT 25°

(Norton, 1941)

Oil	Conc. in H_2O ÷ Conc. in Oil for total Nicotine Conc. of:		Oil	Conc. in H_2O ÷ Conc. in Oil for total Nicotine Conc. of:	
	0.1%	5.0%		0.1%	5.0%
Linseed	0.51	0.76	Sesame	0.39	0.86
Sun flower-seed	0.50	0.81	Peanut	0.38	0.99
Soybean	0.47	0.79	Olive	0.41	0.91
Tung	0.65	0.71	Castor	0.28	0.33
Poppy-seed	0.51	0.89	Pine	0.20	0.11
Cotton-seed	0.36	0.80	Neatsfoot	0.33	1.15
Corn	0.38	0.92	Fish	-	0.78
Rapeseed	0.42	1.03	Petroleum	1.11	1.77

DISTRIBUTION OF NICOTINE COMPOUNDS BETWEEN WATER AND OILS AT 25°

Oil	Nicotine Oleate: Conc. in H_2O ÷ Conc. in Oil for total N. Oleate Conc. of		Nicotine Naphthenate: Conc. in H_2O ÷ Conc. in Oil For total N. Naphthenate Conc. of		Nicotine Stearate: Conc. in H_2O ÷ Conc. in Oil for total N. Stearate Conc. of
	0.1%	5.0%	0.1%	5.0%	0.1%
Linseed	1.30	1.13	1.68	0.70	1.20
Sunflower seed	0.96	0.94	1.02	0.74	0.54
Soybean	1.02	0.98	1.66	0.63	0.65
Tung	0.45	1.27	1.20	0.69	0.73
Poppy seed	1.02	1.12	1.11	0.65	0.51
Cottonseed	0.83	1.05	0.95	0.63	0.61
Corn	1.14	1.15	1.20	0.72	0.51
Rapeseed	1.35	1.41	1.38	1.03	0.71
Sesame	0.95	1.11	1.16	0.68	0.59
Peanut	0.98	1.12	1.26	0.80	0.50
Olive	0.77	1.11	1.07	0.43	0.41
Castor	0.31	0.27	0.48	0.28	0.31
Pine	0.51	0.21	0.49	0.14	0.39
Neatsfoot	0.64	1.15	1.60	1.00	0.66
Fish	-	1.10	1.42	0.74	-
Petroleum	0.98	1.34	1.52	1.59	0.87

ANABASINE $C_{10}H_{14}N_2$

DISTRIBUTION OF ANABASINE BETWEEN WATER AND ORGANIC SOLVENTS
(Bowen, 1949)

Organic Solvent	Dist. Coef. K ($\frac{\text{conc. in Org. Solvent}}{\text{conc. in } H_2O}$) at 4°	20.2°	27°	40°
Petroleum Ether	0.06	-	0.17	-
Gasoline	0.19	-	0.80	0.15
Kerosene	0.08	-	0.25	0.33
Cyclohexane	0.11(6.5°)	-	0.26	0.33
Benzene	0.66	1.32	1.98	-
Toluene	0.57	-	1.59	1.10
Ethyl Ether	0.44	-	0.59	-
Chloroform	3.59	3.96	6.61	-
Carbon Tetrachloride	0.41	-	0.98	-
Ethylene Dichloride	1.28	2.04	3.29	-
o Dichloro Benzene	0.71	-	1.74	1.76

EPHEDRIN $C_6H_5CHOHCH(NHCH_3)CH_3 \cdot H_2O$

The distribution coefficient of Ephedrin between Ethyl Ether and Water, for a concentration of 34.5 millimols per liter of the ether layer divided by 17.3 millimols per liter of the water layer is 2.0 at 22°. (Collander, 1949).

Correction to Vol. 2, 3rd. Ed. Solubilities, p. 677, under Pinene, change Ethyl Acetate to Ethyl Lactate.

CAMPHOR $C_{10}H_{16}O$

BORNEOL $C_{10}H_{17}O$

A method for the determination of the water content of alcohols based upon the clouding points observed in titrating mixtures of Camphor or Borneol and Alcohol with water, is described by Spiridonova, 1940, 1941. The results show the limiting solubility compositions of the ternary mixtures Camphor-Alcohol-Water and Borneol-Alcohol-Water.

Freezing-points of mixtures of Camphor and Palmitin are given by Efremov, Vinogradova, and Tichomirov, 1937.

CAMPHORIC ACID $C_8H_{14}(COOH)_2$

The distribution coefficient ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) of Camphoric Acid Between Ethyl Ether and Water, for concentrations of 1.48-2.29 millimols per liter in the water layer is 25 at 25°. (Collander, 1949, quoted from Chandler, 1908).

BORNYL BROMIDE $C_{10}H_{17}Br$

Freezing-points (M. pts.) are given by Pirsch, 1944, for

Bornyl Bromide + Bornyl Chloride
Bornyl Bromide + Isobornyl Bromide

DECALIN (Naphthaline, Decahydro) $C_{10}H_{18}$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DECALIN AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
p Nitro Aniline	239	Furfural Alcohol	88
o Nitro Benzoic Acid	218	Phenyl Hydrazine	75
Maleic Anhydride	211	Acetonitrile	106
Aceto Acetanilide	144	Ethylene Chlorohydrin	82
Catechol	146	Phenyl Phthalate	57
Antipyrine	127	Acetic Anhydride	83
Methyl Sulfate	146	Ethylene Diacetate	53
Sebacic Acid	122	Tetra Hydro Furfural Alcohol	27
Nitro Methane	116	Aniline	35
m Nitro Acetophenone	106	Acetonyl Acetone	60
Benzyl p Hydroxy Benzoate	92	Triphenyl Phosphite	25
Methanol	101	Sulfur Dioxide	42

SEBACIC ACID $(CH_2)_8(COOH)_2$

SOLUBILITY OF SEBACIC ACID IN FURFURAL

(Trimble, 1941)

t°	Gms. $(CH_2)_8(COOH)_2$ per 100 gms. Sat. Sol.
0	0.7
25	0.8
40	2.5

THE DISTRIBUTION OF SEBACIC ACID BETWEEN WATER AND ORGANIC SOLVENTS

(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration of the latter by difference. The distribution coefficient K is the conc. in the H_2O layer (approx. 0.1%) divided by the conc. in the organic solvent layer.

Solvent in contact with H_2O	Dist. Coef. K	Solvent in contact with H_2O	Dist. Coef. K
n Butanol	< 0.1	Diisopropyl Ketone	< 0.1
Ethyl Acetate	< 0.1	Butyl Acetate	0.11
Ethyl Ether	< 0.1	Methyl Isobutyl Ketone	< 0.1
Chloroform	0.63-0.91	Methyl Propyl Ketone	< 0.1
Skellysolve B	6.5-10.0	Methyl Ethyl Ketone	< 0.1
Carbon Tetrachloride	4.5	Cyclohexane	< 0.1
Benzene	3.6		

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Sebacic Acid between Ethyl Ether and Water, for a concentration of 0.36-0.62 millimols per liter of the water layer is 43-47 at 25°. (Collander, 1949, quoted from Chandler, 1908).

MUCIC ACID DIETHYL ESTER $(CHOH)_4(COOC_2H_5)_2$

The distribution coefficient $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ of Mucic Acid Diethyl Ester between Ethyl Ether and Water, for a concentration of 50 millimols per liter of the water layer is 0.0087 at about 20°. (Collander, 1949, quoted from Collander and Bärlund, 1933).

CAPRINITRILE $CH_3(CH_2)_8CN$

SOLUBILITY OF CAPRINITRILE IN SEVERAL SOLVENTS
(Hoerr, Binkerd, Pool, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_8CN$ per 100 gms. Solvent in:						
	Methanol	95% Ethanol	Isopropanol	n Butanol	Acetone	2-Butanone	Acetonitrile
-40	7.6	7.5	7.5	7.8	40.8	46.0	15.6
-20	170.0	137.0	150.0	156.0	478.0	560.0	730.0
0							

t°	Gms. $CH_3(CH_2)_8CN$ per 100 gms. Solvent in:					
	Tetrachloro Methane	Trichloro Methane	Nitro Ethane	Ethyl Ether	Ethyl Acetate	Butyl Acetate
-40	-	90.	23.6	57.0	23.6	28.8
-20	320	395.	455.0	345.	442.	390.

THE EUTECTIC TEMPERATURES AND COMPOSITIONS OF MIXTURES OF CAPRINITRILE AND OTHER COMPOUNDS
(Hoerr, Binkerd, Pool, and Ralston, 1944)

Mixture	t°	Wt. % Caprinitrile
Caprinitrile + Benzene	-25.9	66.6
Caprinitrile + Cyclohexane	-28.8	29.7
Caprinitrile + Trichloro Methane	-38.9	20.2
Caprinitrile + Glacial Acetic Acid	-15.1	96.5

CAPRIC ACID (Decanoic Acid) $CH_3(CH_2)_8COOH$

SOLUBILITY OF CAPRIC ACID IN WATER

(Ralston and Hoerr, 1942; Eggenberger, Broome, Ralston, and Harwood, 1949)

t°	Gms. $CH_3(CH_2)_8COOH$ per 100 cc Sat. Sol.	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_8COOH$ per 100 cc Sat. Sol.	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. H_2O
0	-	0.0095	45	-	0.023
20	-	0.015	50	0.0081	-
30	0.0064	0.0180	60	0.0100	0.027
40	0.0072	-	100	-	0.10*

*Lewkowitch, Chem. Tech. and Anal. of Oils, Fats and Waxes, 6th. Ed., Vol. 1, 1921. The authors give no explanation of the divergence of the above results.

SOLUBILITY OF CAPRIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. Solvent in: 95% C_2H_5OH	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	60.6	45.3	42.4	145.	-
10	93.5	112.	100.	398.	567.
20	440.0	407.	318.	8230.	8230
30	8980.0	4660.	7040.	∞	∞

SOLUBILITY OF CAPRIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1944)

t°	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. Solvent in: Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	27.0	61.	34.2	44.6
10	342.	64.0	122.	90.	111.
20	7600.	210.	326.	289.	330.
30	∞	4650.	6550.	7850.	8230.

t°	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. Solvent in: Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	80.	67.	59.	9.2	11.8
10	180.	140.	103.	12.5	21.0
20	510.	360.	280.	55.0	66.0
30	9900.	5750.	4650.	7000.	7600.

THE EUTECTICS OF MIXTURES OF CAPRIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_8COOH$
Capric Acid + Cyclohexane	-3.2	14.1
Capric Acid + Benzene	-2.0	34.5
Capric Acid + Glacial Acetic Acid	+8.6	55.1

$C_{10}H_{20}O_2$

SOLUBILITY OF CAPRIC ACID IN SEVERAL SOLVENTS

(Hoerr, Sedgwick, and Ralston, 1946)

t°	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. Solvent in:			
	Toluene	o Xylene	Chloro Benzene	Furfural
-10	25.2	20.3	16.7	-
0	57.	47.9	43.0	3.8
+10	127.	117.	108.	8.9
20	323.	316.	305.	42.5
30	4100.	4050.	4500.	3470.0

t°	Gms. $CH_3(CH_2)_8COOH$ per 100 gms. Solvent in:			
	Nitro Benzene	1,4 Dioxane	1,4 Dichloro Ethane	Nitro Methane
0	-	-	21.7	-
10	18.0	-	78.0	-
20	131.0	356.	260.	4.6
30	3550.	4450.	4060.	9.4
40	∞	∞	∞	14.3
50	-	-	-	25.6

CAPRAMIDE (Decanamide) $CH_3(CH_2)_8CONH_2$

SOLUBILITY OF CAPRAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

t°	Gms. $CH_3(CH_2)_8CONH_2$ per 100 gms. Solvent in:					
	Methanol	95% Ethanol	Isopropanol	n Butanol	Acetone	2-Butanone
10	6.8	4.3	6.0	3.5	2.0	2.2
30	15.2	12.0	10.9	9.1	3.8	3.8
50	67.	43.7	37.2	30.9	15.4	13.3
60	125.	88.	72.	118.	23.0(56.5°)	30.8
70	170.(64.7°)	174.	140.	-	-	79.0
80	-	350.(78.5°)	380.(82.3°)	-	-	189.0
90	-	-	-	690.	-	-
100	-	-	-	∞	-	-

t°	Gms. $CH_3(CH_2)_8CONH_2$ per 100 gms. Solvent in:						
	Ethyl Acetate	Butyl Acetate	Nitro Ethane	Tetra Chloro Methane	Aceto-nitrile	Benzene	Cyclo-hexane
10	0.5	0.9	0.8	-	0.3	0.6	-
30	2.2	2.9	1.1	0.2	0.9	0.8	0.4
50	10.2	9.6	4.2	0.5	5.1	3.2	0.5
60	23.9	39.5	-	2.6	12.1	11.4	0.6
70	59.0	-	25.2	23.6	39.8	57.	3.3
80	123.(77.2°)	-	-	59.(76°)	175.0(82°)	195.	150.0(81.4°)
90	-	505.	850.	-	-	-	-
100	-	∞	∞	-	-	-	-

N-CYCLO HEXYL-BUTAN-1-SULFAMID $C_{10}H_{21}O_2NS$

Freezing-points of mixtures of N-Cyclo Hexyl-Butan-1-Sulfamid and N-Cyclo Hexyl-Butan-2-Sulfamide are given by Asinger, Ebender, and Bock, 1942.

DECANE $CH_3(CH_2)_8CH_3$

The critical solution temperature of mixtures of Decane and Aniline is 77.5°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

2-METHYL NONANE $C_{10}H_{22}$

The critical solution temperature of mixtures of 2-Methyl Nonane and Aniline is 80.3°.(Ludeman, 1940, quoted from Evans, 1937).

DECANOL $CH_3(CH_2)_8CH_2OH$

SOLUBILITY OF DECANOL IN SEVERAL SOLVENTS
(Hoerr, Harwood, and Ralston, 1944)

Gms. $CH_3(CH_2)_8CH_2OH$ per 100 gms. Solvent in:

t°	Methanol	95% Ethanol	Iso Propanol	n Butanol	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether
-40	7.1	7.1	14.8	17.4	-	6.8	8.0
-20	48.5	43.6	55.	53.	9.7	33.3	38.9
0	1310.	1150.	635.	475.	240.	390.	520.
20							

Gms. $CH_3(CH_2)_8CH_2OH$ per 100 gms. Solvent in:

t°	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Nitro Ethane	Acetronitrile
-20	14.7	17.9	13.6	16.3	-	-
0	320.	320.	335.	355.	7.1	5.8
+10	∞	∞	∞	∞	16.9	21.9
20	-	-	-	-	∞	52.0

THE EUTECTICS OF MIXTURES OF DECANOL AND OTHER COMPOUNDS

Mixture	t°	Gms. Decanol per 100 gms. Mixture
Decanol + Benzene	-7.5	38.0
Decanol + Cyclohexane	-10.8	20.3
Decanol + Tetra Chloro Methane	-25.2	5.7

SOLUBILITY OF 1-DECANOL IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF THE HIGHER FATTY ACIDS AT 25° (?)

(Harkins and Oppenheimer, 1949)

Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_{10}H_{21}OH$ per 1000 gms. Soap Solution	Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_{10}H_{21}OH$ per 1000 gms. Soap Solution
Octylic Acid	0.003	Laurinic Acid	0.111
Nonylic Acid	0.063	Myristinic Acid	0.122
Capric Acid	0.0923	Penta Decanoic Acid	0.136
Undecylic Acid	0.104	Na Dodecyl Sulfate	0.138

The saturated solutions were analyzed by turbidity measurement.

DECA METHYLENE GLYCOL (1, 10-Decanediol) $CH_2OH(CH_2)_8CH_2OH$

The distribution coefficient of Deca Methylene Glycol between Ethyl Ether and Water, for a concentration of 99.1 millimols per liter of the ether layer divided by 4.6 millimols per liter of the water layer is 21 at 19°. (Collander, 1949).

DECYL AMINE $CH_3(CH_2)_9NH_2$

SOLUBILITY OF DECYLAMINE IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF HIGHER FATTY ACIDS AT 25° (?)

(Harkins and Oppenheimer, 1949)

Potassium Salt of: (0.3 mol. per 1000 gms.)	Mol. $C_{10}H_{21}NH_2$ per 1000 gms. Soap Solution	Potassium Salt of: (0.3 mol. per 1000 gms.)	Mol. $C_{10}H_{21}NH_2$ per 1000 gms. Soap Solution
Octylic Acid	0.004	Laurinic Acid	0.113
Nonylic Acid	0.102	Myristinic Acid	0.113
Capric Acid	0.110	Penta Decanoic Acid	0.119
Undecylic Acid	0.113	Na Dodecyl Sulfate	0.110

The saturated solutions were analyzed by turbidity measurement.

SOLUBILITY OF DECYLAMINE IN SEVERAL SOLVENTS.

(Ralston, Hoerr, Pool, and Harwood, 1944)

Gms. $CH_3(CH_2)_9NH_2$ per 100 gms. Solvent in:

t°	Methanol	95 Wt. % Ethanol	Iso Propanol	n Butanol	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether
-40	31.0	8.5	11.1	9.5	-	17.7	1.4
-20	172.	91.	40.	30.8	10.5	43.0	12.1
0	550.	350.	228.	182.3	57.0	148.0	86.0
+20	∞	∞	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_9NH_2$ per 100 gms. Solvent in:						
	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Acetonitrile	Benzene	Cyclohexane
-20	14.8	13.3	6.6	10.0	2.8	-	-
0	69.0	69.0	54.0	65.0	12.7	-	-
+10	-	-	-	-	-	395	318
20	∞	∞	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF DECYLAMINE AND OTHER COMPOUNDS

Mixture	t°	Wt. % $CH_3(CH_2)_9NH_2$
Decylamine + Benzene	-5.6	31.7
Decylamine + Cyclohexane	-10.5	12.8
Decylamine + Tetra Chloro Methane	-25.8	7.2

Results for the solubility of Decylamine Hydrochloride in 95% Ethanol at temperatures between 10° and 70° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

METHYL NAPHTHALENES α AND β $C_{11}H_7(CH_3)$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF α AND OF β METHYL NAPHTHALENES, EACH SEPARATELY, WITH SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. with:	
	α $C_{11}H_7(CH_3)$	β $C_{11}H_7(CH_3)$
Ethylene Glycol	217	216
Triethanol Amine	177	178
Diethanol Amine	182	182
Acetamide	169.5	-
p Amino Acetanilide	165	-
Glycerol Monochloro Hydrine	153	155
Ethanol Amine	134	134
Diethylene Glycol	126	127
Monoacetin	124	-
Resorcinol	108	-
Triethylene Glycol	62	61
Ethylene Diformate	25	31
Ammonia	28	-
Methanol	< -78	-

PENTA METHYL CHLORO BENZENE $C_6(CH_3)_5Cl$

SOLUBILITY OF PENTA METHYL CHLORO BENZENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $C_6(CH_3)_5Cl$ in Saturated Solution
8.77	0.0349
19.92	0.0488
29.93	0.0737
41.88	0.1010

ANTIPYRINE $NCH_3NC_6H_5COCH:C(CH_3)$

SOLUBILITY OF ANTIPYRINE IN WATER
(Kaplan and Rabinovich, 1948)

t°	Gms. $C_{11}H_{12}N_2O$ per 100 gms. Sat. Solution	Gms. $C_{11}H_{12}N_2O$ per 100 gms. H_2O	t°	Gms. $C_{11}H_{12}N_2O$ per 100 gms. Sat. Solution	Gms. $C_{11}H_{12}N_2O$ per 100 gms. H_2O
14.5	44.9	82.0	35.5	63.5	174.9
20.5	49.9	99.4	41.5	69.0	225.0
24.5	54.0	117.9	55.0	77.0	335.0
30.0	59.0	144.0	72.0	86.0	600.0

SOLUBILITY OF ANTIPYRINE IN ETHYL ALCOHOL
(Kaplan and Rabinovich, 1948)

t°	Gms. $C_{11}H_{12}N_2O$ per 100 gms. Sat. Solution	Gms. $C_{11}H_{12}N_2O$ per 100 gms. C_2H_5OH	t°	Gms. $C_{11}H_{12}N_2O$ per 100 gms. Sat. Solution	Gms. $C_{11}H_{12}N_2O$ per 100 gms. C_2H_5OH
14.0	40.0	66.0	41.0	60.7	154.5
18.5	43.7	77.6	56.5	67.9	210.6
24.5	48.0	91.5	71.0	77.4	343.1
31.5	53.3	111.0			

SOLUBILITY OF ANTIPYRENE IN DICHLORO ETHANE
(Kaplan and Rabinovich, 1948)

t°	Gms. $C_{11}H_{12}N_2O$ 100 gms. Sat. Solution	Gms. $C_{11}H_{12}N_2O$ 100 gms. $C_2H_4Cl_2$	t°	Gms. $C_{11}H_{12}N_2O$ 100 gms. Sat. Solution	Gms. $C_{11}H_{12}N_2O$ 100 gms. $C_2H_4Cl_2$
12.5	20.0	23.8	44.0	35.1	54.1
15.5	21.0	26.9	55.0	40.0	66.9
20.5	23.2	31.9	64.0	46.0	85.2
26.5	26.5	36.5	71.0	52.0	107.0
36.0	30.9	44.6			

The distribution coefficient of Antipyrine ($\frac{\text{conc. Ether}}{\text{conc. } H_2O}$) between Ethyl Ether and Water, for a concentration of about 100 millimols per liter in the water layer is 0.073. (Collander, 1949, quoted from Bärlund, 1929).

Freezing-points for mixtures of Antipyrine and Cholesterine are given by Brandstatter, 1943.

TRYPTOPHANE $C_{11}H_{12}O_2N_2$

SOLUBILITY OF TRYPTOPHANE IN ACETIC AND IN BUTYRIC ACID AT 18°
(Przylecki and Kasprzyle-Czaykowska, 1938)

100 cc Acetic Acid dissolve 0.85 gm. $C_{11}H_{12}O_2N_2$
100 cc Butyric Acid dissolve 0.053 gm. $C_{11}H_{12}O_2N_2$

TRYPTOPHANE PHOSPHOTUNGSTATE $(C_{11}H_{12}O_2N_2)_3 \cdot H_3PO_4 \cdot 12WO_3 \cdot 10H_2O$

THE SOLUBILITY OF TRYPTOPHANE PHOSPHOTUNGSTATE IN AQUEOUS 0.25 NORMAL HYDROCHLORIC ACID

(Van Slyke, Hiller and Dillon, 1942)

The determinations were made by the resolution method and are presented in the form of a diagram from which the following approximate values, expressed as milligrams of Amino Acid Nitrogen per liter, were read,

t°	Milligrams Amino Acid N per liter	t°	Milligrams Amino Acid N per liter
0	39	25	140
10	65	30	175
20	110	40	300

It was also found that one liter of Aqueous 0.25 n HCl solution containing 50 gm. Phosphotungstic Acid, saturated with Tryptophane Phosphotungstate, contain 4.43 millimols Tryptophane at 22°.

sec AMYL BENZENE $C_6H_5CH(CH_3)(CH_2)_2CH_3$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF sec. AMYL BENZENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	210	Methyl Sulfate	28
Triethylene Glycol	178	Phenyl Ethanol Amine	23
p Nitro Aniline	171	Nitro Methane	25
p Amino Acetophenone	125	Methanol	-6
Ethylene Diformate	112	Furfural Alcohol	11
Salicyl Alcohol	104	Acetonitrile	-5
Maleic Anhydride	123	Ethylene Chlorohydrin	-22
Aceto Acetanilide	77	Acetic Anhydride	-25
p Amino Ethyl Acetanilide	82	Ethylene Diacetate	-41

ETHYL ISOPROPYL BENZENE $C_6H_4(C_2H_5)(CH_3)_2CH$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF ETHYL ISOPROPYL BENZENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	213	Phenyl Ethanol Amine	27
p Phenylene Diamine	185	Nitro Methane	9
Triethylene Glycol	177	Methanol	-5
p Nitro Aniline	150	Furfuryl Alcohol	2
p Amino Acetophenone	121	Acetonitrile	-30
Ethylene Diformate	104	Ethylene Dichlorohydrin	-60
Salicyl Alcohol	107	Acetic Anhydride	-35
Maleic Anhydride	101	Ethylene Diacetate	-50
Methyl Sulfate	7		

METHYL DIETHYL BENZENE $C_6H_3(CH_3)(C_2H_5)_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF METHYL DIETHYL BENZENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethyl Glycol	207	Phenyl Ethanol Amine	5
p Phenylene Diamine	183	Nitro Methane	11
Triethylene Glycol	172	Methanol	10
p Nitro Aniline	139	Furfural Alcohol	2
p Amino Acetophenone	95	Acetonitrile	-23
Ethylene Diformate	101	Ethylene Chlorohydrin	-50
Salicyl Alcohol	86	Acetic Anhydride	-27
Maleic Anhydride	79	Ethylene Diacetate	-42
Methyl Sulfate	13		

HENDECANOIC ACID (n Undecylic Acid) $CH_3(CH_2)_9COOH$

SOLUBILITY OF HENDECANOIC ACID IN WATER

(Ralston and Hoerr, 1942; Eggenberger, Broome, Ralston, and Harwood, 1949)

t°	Gms. $C_{11}H_{22}O_2$ per 100 gms.		t°	Gms. $C_{11}H_{22}O_2$ per 100 gms.	
	Sat. Sol.	H_2O		Sat. Sol.	H_2O
0	-	0.0063	45	-	0.013
20	-	0.0093	50	0.0026	-
30	0.00198	0.011	60	0.0032	0.015
40	0.0023	-			

The authors give no explanation of the divergence of the above results.

SOLUBILITY OF HENDECANOIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_9COOH$ per 100 gms. Solvent in:				
	95% Ethanol	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	85.2	50.2	47.9	-	-
10	190.	149.	139.	208.	-
20	706.	706.	521.	663.	800.
30	∞	∞	∞	∞	∞

SOLUBILITY OF HENDECANOIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_9COOH$ per 100 gms. Solvent in:				
	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	35.1	74.0	38.7	55.
10	150.	88.	161.	114.	145.
20	525.	318.	485.	425.	515.
30	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_9COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	105.	82.	64.	8.1	8.7
10	235.	182.	131.	13.2	17.3
20	740.	540.	415.	131.0	185.
30	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF UNDECYLIC ACID AND OTHER COMPOUNDS
(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_9COOH$
Undecylic Acid + Cyclohexane	-5.9	16.2
Undecylic Acid + Benzene	-4.0	38.9
Undecylic Acid + Glacial Acetic Acid	+8.0	57.5

HENDECANE (Undecane) $CH_3(CH_2)_9CH_3$

The critical solution temperature of mixtures of Undecane and Aniline is 80.6°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

HENDECANOL $CH_3(CH_2)_9CH_2OH$

SOLUBILITY OF HENDECANOL IN AQUEOUS 0.3 MOLAR SOLUTIONS OF POTASSIUM SALTS OF THE HIGHER FATTY ACIDS AT (?)
(Harkins and Oppenheimer, 1949)

Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_{11}H_{23}OH$ per 1000 gms. Soap Solution	Potassium Salt of: (0.3 mol. per 1000 gms.)	Mols. $C_{11}H_{23}OH$ per 1000 gms. Soap Solution
Octylic Acid	0.003	Laurinic Acid	0.1075
Nonylic Acid	0.072	Myristinic Acid	0.116
Capric Acid	0.0865	Pentadecanoic Acid	0.114
Undecylic Acid	0.107	Na Dodecyl Sulfate	0.125

The saturated solutions were analyzed by turbidity measurement.

HENDECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{10}NH_2 \cdot HCl$

Results for the solubility of Hendecylamine Hydrochloride in 95% Ethanol at temperatures between 10° and 75° are given in the form of a diagram by Harwood, Ralston and Selby, 1941.

THIANTHRENE $C_6H_4SC_6H_4S$

Freezing-point data for binary mixtures of the following analogous compounds are given by Cullinane and Rees, 1940.

Phenoxazine	$C_6H_4OC_6H_4NH$
Phenthiazine	$C_6H_4SC_6H_4NH$
Diphenyl Dioxide	$C_6H_4OC_6H_4O$
Phenoxythionine	$C_6H_4OC_6H_4S$
Thianthrene	$C_6H_4SC_6H_4S$

ACENAPHTHENE $C_{10}H_6(CH_2)_2$

Freezing-point data are given for:

Acenaphthene + Fluorene (Klochko-Zhovnir, 1948)
Acenaphthene + Phenthrene " " "
Acenaphthene + Fluoranthene (Klochka-Zhovnir, 1949)
Acenaphthene + Acetamide (Kofler, 1948)

DIPHENYL $C_6H_5 \cdot C_6H_5$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIPHENYL AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Ethylene Glycol	217	Ethanol Amine	133
Triethanol Amine	185	Diethylene Glycol	129
Diethanol Amine	183	Resorcinol	109
Acetamide	167	Triethylene Glycol	65

AZOBENZENE $C_6H_5N{:}NC_6H_5$

Freezing-point data are given for:

Azobenzene + Acetanilide (Kofler, 1949)
Azobenzene + Diphenyl " "
Azobenzene + Dibenzyl (Straube and Malotaux, 1940)
Azobenzene + Dibenzyl (Kofler, 1948)

Correction to Vol. 2, 3rd. Ed. Solubilities, p. 700, under Phenyl Ether change critical solution temperature to demixing temperature.

DIPHENYL SULFOXIDE $(C_6H_5)_2SO$

Freezing-point data are given by Rheinboldt and Giesbrecht, 1947, for:

Diphenyl Sulfoxide + Diphenyl Selenone
Dibenzyl Sulfone + Dibenzyl Selenoxide
Diphenyl Sulfone + Diphenyl Selenoxide
Diphenyl Sulfone + Diphenyl Selenone

DIPHENYL AMINE $(C_6H_5)_2NH$

Freezing-point data are given by Nelson and Smith, 1942, for mixtures of Diphenyl Amine and each of the following compounds; Phenoxathin, p Nitro Phenetol, 1-Nitro Naphthalene, Dibenzo Furan, and Pheno Thiazine.

4-AMINO AZOBENZENE $NH_2C_6H_4N{:}NC_6H_5$

SOLUBILITY OF 4-AMINO AZOBENZENE IN AQUEOUS SOLUTIONS OF CAFFEINE
(Neish, 1948)

Note. The solutions were shaken frequently at 37° for 5 hours and allowed to stand 1 hour at room temperature. The Amine content of the clear solution was determined by a colorimetric diazotization procedure.

Gms. Caffeine per 100 cc Aq. Sol.	Milligms. $C_{12}H_{11}N_3$ per liter Aq. Sol.	Gms. Caffeine per 100 cc Aq. Sol.	Milligms. $C_{12}H_{11}N_3$ per liter Aq. Sol.
0.0 (=H_2O)	0.037	0.15	0.075
0.01	0.039	0.25	0.081
0.05	0.053	0.35	0.087
0.10	0.056	0.50	0.098

BENZIDINE $NH_2C_6H_4C_6H_4NH_2$

SOLUBILITY OF BENZIDINE IN AQUEOUS SOLUTIONS OF CAFFEINE
(Neish, 1948)

See note above.

Gms. Caffeine per 100 cc Aq. Sol.	Milligms. $C_{12}H_{12}N_2$ per liter Aq. Sol.	Gms. Caffeine per 100 cc Aq. Sol.	Milligms. $C_{12}H_{12}N_2$ per liter Aq. Sol.
0.0 (=H_2O)	0.270	0.50	0.650
0.1	0.430	0.75	1.060
0.25	0.580	1.00	1.250

4,4 DIAMINO DIPHENYL SULFONE $H_2N{\cdot}C_6H_4SO_2C_6H_4NH_2$

Freezing-point data for mixtures of 4,4 Diamino Diphenyl Sulfone and 4,4 Diamino Benzophenone are given by Kuhn, Möller, Wendt, and Beinert, 1942.

α KETO γ PHENYL ADIPIC ACID $C_{12}H_{12}O_5$

The distribution coefficient of α Keto γ Phenyl Adipic Acid between Ethyl Ether and Water, for concentrations of 5.44 to 66.3 millimols per liter of the ether layer divided by 3.32 to 18.0 millimols per liter of the water layer is 1.6 to 3.7 at 25°. (Collander, 1949).

β PHENYL ADIPIC ACID $COOH(CH_2)_3CH(C_6H_5)COOH$

THE DISTRIBUTION OF β PHENYL ADIPIC ACID BETWEEN WATER AND OTHER SOLVENTS
(Marvel and Richards, 1949)

The determinations were made by titrating the aqueous layer before and after shaking with the organic solvent at about 26° and calculating the concentration of the latter by difference. The Distribution Coefficient K is the concentration in the H_2O layer (approx. 0.1%) divided by the concentration in the organic solvent layer.

Results for:

H_2O / n Butanol	H_2O / Ethyl Acetate	H_2O / Ethyl Ether	H_2O / Chloroform	H_2O / Skellysolve B
< 0.1	< 0.1	< 0.1	4.0	10+

ARBUTIN $C_{12}H_{16}O_7$

The distribution coefficient of Arbutin between Ethyl Ether and Water, for a concentration of 300 millimols per liter of the water layer is 0.00074 at about 20°. (Collander, 1949, quoted from Collander and Bärlund, 1933).

HEXAMETHYL BENZENE $C_6(CH_3)_6$

SOLUBILITY OF HEXAMETHYL BENZENE IN BENZENE
(Smyth and Lewis, 1940)

t°	Mol. Fraction $C_6(CH_3)_6$ in Saturated Solution
8.77	0.0277
19.92	0.0382
29.93	0.0583
41.88	0.0814

TRIETHYL BENZENE $C_6H_3(C_2H_5)_3$

DIISOPROPYL BENZENE $C_6H_4[CH(CH_3)_2]_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF TRIETHYL BENZENE AND OF DIISOPROPYL BENZENE, EACH SEPARATELY, WITH OTHER SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of Mixture with: Triethyl Benzene	Diisopropyl Benzene	Solvent	C.S.T. of Mixture with: Triethyl Benzene	Diisopropyl Benzene
Hydroquinone	-	> 237	Phenyl Ethanol Amine	34	55
Dimethylene Glycol	219	219	m Dinitro Benzene	-	< 63
p Phenylene Diamine	-	193	Sebacic Acid	-	< 120
Triethylene Glycol	188	191	2,4 Dinitro Chloro Benzene	-	< 25
Benzidine	185	202	Nitro Methane	26	22
p Nitro Aniline	159	172	Methanol	19	9
o Nitro Benzoic Acid	< 136	149	Furfuryl Alcohol	16	20
p Amino Acetophenone	117	147	Phenyl Hydrazine	13	27
Ethyl Diformate	116	122	Acetonitrile	-7	-15
Salicyl Alcohol	109	126	Ethylene Chlorohydrin	-15	-5
Maleic Anhydride	112	130	Phenyl Phthalate	-	< -40
o Phenylene Diamine	-	111	Acetic Anhydride	-12	-23
Aceto Acetanilide	77	108	Ethylene Diacetate	-26	-33
p Amino Ethyl Acetanilide	84	100	Tetrahydro Furfuryl Alcohol	< -78	-
Methyl Sulfate	41	32	Sulfur Dioxide	-	< -78

TRIETHYL CITRATE $C_3H_4(OH)(COOC_2H_5)_3$

The distribution coefficient of Triethyl Citrate between Ethyl Ether and Water, $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ is 4.4 at 23°. (Collander, 1949, quoted from Bärlund, 1933).

DEXTRINS (Schardinger, α, β, γ) $(C_6H_{10}O_5)_x$, $C_{12}H_{20}O_{10}$(?)

SOLUBILITY OF α, β AND γ DEXTRINS IN WATER AND IN 60% PROPYL ALCOHOL AT 27°

(French, Levine, Pazur and Norberg, 1949)

Solutions containing an excess of each dextrine were allowed to stand several days with occasional shaking at room temperature. The concentrations of the dextrins in the saturated solutions were determined by measuring the rotation.

Solvent	Grams per 100 cc Saturated Solution		
	α Dextrin	β Dextrin	γ Dextrin
Water	14.5	1.85	23.2
Aqueous 60% n Propyl Alcohol	0.4 - 1.2	0.54	0.27

Determinations were also made of the solubility of the three dextrins in water shaken with an excess of various immiscible organic solvents (precipitants).

DEXTRINE ACETATES α, β and γ

SOLUBILITY OF DEXTRINE ACETATES IN SEVERAL SOLVENTS AT 27°

(French, Levine, Pazur, and Norberg, 1949)

The pure acetates were dissolved in about 15 parts of solvent and after crystallization on standing, were equilibriated for several days with frequent shaking. The concentrations of acetate in the solutions were determined by measuring the rotation.

Solvent	Grams per 100 cc Saturated Solution		
	α Acetate	β Acetate	γ Acetate
Toluene	0.22	0.24	very soluble
Methanol	1.39	2.54	" "
Ethyl Acetate	8.84	very soluble	" "
Butyl Acetate	0.67	17.8	11.0

SUCROSE (Cane Sugar, Saccharose) $C_{12}H_{22}O_{11}$

THE SOLUBILITY OF SUCROSE IN WATER IN THE EUTECTIC REGION

(Young and Jones, 1949)

The system was studied by warming curves, solubility measurements, melting-points and microscopy.

t°	Gms. $C_{12}H_{22}O_{11}$ per 100 gms. Sat. Sol.	Solid Phase
-0.6	10.0	Ice
-1.5	20.0	"
-2.6	30.0	"
-4.4	40.0	"
-7.0	50.0	"
-11.6	60.0	"
-19.0	70.0	"
-30.	80.0	"
-13.95*	63.6	Ice + $C_{12}H_{22}O_{11}$
-10.0	63.7	$C_{12}H_{22}O_{11}$
0	64.4	"
+10	65.4	"
+30	68.6	"
+50	72.3	"
-10.5*	58.0	Ice + $C_{12}H_{22}O_{11}\cdot 2.5H_2O$
0	63.2	$C_{12}H_{22}O_{11}\cdot 2.5H_2O$
+10.	68.5	"
20	73.8	"
30	79.4	"
40	85.2	"
45.7**	88.37	"
-9.5*	56.2	Ice + $C_{12}H_{22}O_{11}\cdot 3.5H_2O$
0	63.1	$C_{12}H_{22}O_{11}\cdot 3.5H_2O$
+10	70.6	"
20	78.2	"
27.8**	84.44	"
-9.0*	55.1	Ice + Phase III
-5.0	58.5	Phase III
0	62.9	"
+5	67.5	"
10	72.2	"
-8.5*	54.0	Ice + Phase IV
-5.0	59.9	Phase IV
0	62.7	"
+5	69.3	"

Phases III and IV not identified. The eutectic points of four other unidentified phases are also given.

*(Eutectic) **(m. pt.)

SOLUBILITY OF SUCROSE IN WATER AT HIGH TEMPERATURES

(Taylor, 1947)

In order to avoid the filtration and handling of highly concentrated, viscous Sucrose solutions, the saturation points were determined by observing, microscopically, in a specially designed apparatus, the behavior of sucrose crystals in solutions of accurately known concentrations, during both falling and rising temperature. The temperatures of incipient healing and erosion of the crystals were observed and the mean of these taken as the point of saturation.

t°	Gms. $C_{12}H_{22}O_{11}$ per 100 gms. Sat. Sol.	t°	Gms. $C_{12}H_{22}O_{11}$ per 100 gms. Sat. Sol.	t°	Gms. $C_{12}H_{22}O_{11}$ per 100 gms. Sat. Sol.
64	75.026	70	76.400	76	77.825
65	75.251	71	76.634	77	78.068
66	75.478	72	76.869	78	78.312
67	75.706	73	77.106	79	78.558
68	75.936	74	77.345	80	78.805
69	76.168	75	77.584	81	79.053
				82	79.305

The distribution coefficient of Sucrose between Ethyl Ether and Water, $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ for a concentration of about 780 millimols per liter in the water layer is 0.0000011 at 18°. (Collander, 1949).

LAURONITRILE $CH_3(CH_2)_{10}CN$

SOLUBILITY OF LAURONITRILE IN SEVERAL SOLVENTS

(Hoerr, Binkherd, Pool, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{10}CN$ per 100 gms. Solvent in:						
	Methanol	95% Ethanol	Isopropanol	n Butanol	Acetone	2-Butanone	Acetonitrile
-40	2.0	2.4	2.5	7.9	7.3	11.4	0.9
-20	5.1	5.6	5.6	22.1	32.6	38.7	6.9
0	163.	181.	212.	830.	660.	755.	1200.
+10	∞	∞	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{10}CN$ per 100 gms. Solvent in:					
	Tetra Chloro Methane	Trichloro Methane	Nitro Ethane	Ethyl Ether	Ethyl Acetate	Butyl Acetate
-40	-	35.1	7.9	17.8	8.7	11.3
-20	24.0	84.	22.1	43.0	33.2	24.3
0	515.	720.	830.	480.	690.	560.
+10	∞	∞	∞	∞	∞	∞

THE EUTECTIC TEMPERATURES AND COMPOSITIONS OF MIXTURES OF LAURONITRILE AND OTHER COMPOUNDS

(Hoerr, Binkherd, Pool, and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{10}CN$
Lauronitrile + Benzene	-14.8	51.1
Lauronitrile + Cyclohexane	-15.1	19.9
Lauronitrile + Trichloro Methane	-27.9	7.9
Lauronitrile + Glacial Acetic Acid	-0.7	75.9

LAURIC ACID (Dodecanoic Acid) $CH_3(CH_2)_{10}COOH$

SOLUBILITY OF LAURIC ACID IN WATER

(Ralston and Hoerr, 1942;
Eggenberger, Broome, Ralston, and Harwood, 1949)

t°	Gms. $CH_3(CH_2)_{10}COOH$ per:		t°	Gms. $CH_3(CH_2)_{10}COOH$ per:	
	100 cc Sat. Sol.	100 gms. H_2O		100 cc Sat. Sol.	100 gms. H_2O
0	-	0.0037	45	-	0.0075
20	-	0.0055	50	0.00092	-
30	-	0.0063	60	0.00116	-
40	0.00077	-	100	-	0.0087

The authors give no explanation of the divergence of the above results.

SOLUBILITY OF LAURIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{10}COOH$ per 100 gms. Solvent in:					
	95 Wt.% Ethanol	99.4 Wt. % Ethanol	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	15.2	20.4	8.95	11.5	-	-
10	34.0	41.6	21.9	24.7	32.3	-
20	91.2	105.	60.5	64.7	93.6	81.8
30	260.	292.	218.	202.	260.	297.
40	1410.	1540.	1590.	1825.	1390.	1480.
50	∞	∞	∞	∞	∞	∞

SOLUBILITY OF LAURIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{10}COOH$ per 100 gms. Solvent in:				
	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	9.2	22.4	9.4	13.0
10	19.8	20.5	39.1	18.5	26.8
20	68.0	53.	83.	52.	68.
30	215.	160.	207.	250.	212.
40	1310.	835.	2120.	1250.	1350.
50	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{10}COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	12.7	21.5	21.4	1.9	2.1
10	42.1	44.1	37.2	2.8	2.8
20	120.	100.	83.0	5.4	7.6
30	383.	253.	217.	16.3	24.4
40	2250.	1270.	1070.	1460.	1540.
50	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF LAURIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{10}COOH$
Lauric Acid + Cyclohexane	3.2	6.8
Lauric Acid + Benzene	4.5	11.2
Lauric Acid + Glacial Acetic Acid	12.8	17.3

SOLUBILITY OF LAURIC ACID IN SEVERAL SOLVENTS
(Hoerr, Sedgwick, and Ralston, 1946)

t°	Gms. $CH_3(CH_2)_{10}COOH$ per 100 gms. Solvent in:			
	Toluene	o Xylene	Chloro Benzene	Furfural
-10	5.2	3.6	2.0	-
0	15.3	11.2	10.6	-
+10	40.6	34.8	31.9	0.3
20	97.0	92.	87.0	3.7
30	215.	238.	239.0	20.9
40	1410.	1360.	1360.	1210.

t°	Gms. $CH_3(CH_2)_{10}COOH$ per 100 gms. Solvent in:			
	Nitro Benzene	1, 4 Dioxane	1, 2 Dichloro Ethane	Nitro Methane
0	-	-	1.2	-
10	2.7	-	6.7	-
20	8.8	101.	36.5	1.1
30	66.3	246.	170.	2.8
40	790.	1270.	1230.	6.6
50	∞	∞	∞	9.7
60				15.7
70				34.1

Freezing-point data for mixtures of Lauric Acid and Palmitin are given by Efremov, Vinogradova, and Tichomirova, 1937.

LAURO 4-ANISIDINE, 2-SODIUM SULFONATE

Results for the solubility of this compound in water are given in the form of a diagram, showing that above a certain temperature the increase in solubility is extremely rapid with small increments of temperature. See note under Dodecyl Salts p.748. (Adam and Pankhurst, 1946).

LAURAMIDE (Dodecanamide) $CH_3(CH_2)_{10}CONH_2$

SOLUBILITY OF LAURAMIDE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Pool, 1943)

t°	Grams $CH_3(CH_2)_{10}CONH_2$ per 100 gms. Solvent in:					
	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Acetone	2-Butanone
10	4.2	2.9	3.7	2.2	1.3	1.2
30	12.4	11.4	11.4	10.1	3.4	3.8
50	77.0	54.0	47.5	38.1	18.3	17.6
60	164.0	102.0	86.0	-	30.5(56.5°)	41.6
70	206.(64.7°)	193.0	154.0	126.	-	93.0
80	-	370.(28.5°)	357.(82.3°)	-	-	194.0(79.6°)
90	-	-	-	580	-	-
100	-	-	-	3550.	-	-

t°	Gms. $CH_3(CH_2)_{10}CONH_2$ per 100 gms. Solvent in: Ethyl Acetate	Butyl Acetate	Nitro Ethane	Tetrachloro Methane	Aceto-nitrile	Benzene	Cyclo-hexane
10	0.5	0.4	0.8	-	0.3	0.6	-
30	2.5	3.0	1.1	0.4	0.9	0.8	0.5
50	12.9	12.4	3.9	1.5	5.1	3.2	0.6
60	29.4	-	-	9.9	12.1	11.4	1.3
70	68.0	52.0	24.2	40.8	39.8	57.0	23.9
80	133.(77.2°)	-	-	72.0(76°)	175.0(82°)	195.0	163./81.4°)
90	-	330.	495.	-	-	-	-
100	-	2550.	5100.	-	-	-	-

DODECYL AMMONIUM CHLORIDE $CH_3(CH_2)_{11}NH_3Cl$

SOLUBILITY OF DODECYL AMMONIUM CHLORIDE IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL

(Ralston and Hoerr, 1946)

Gms. C_2H_5OH per 100 gms. aqueous Solvent	Gms. $CH_3(CH_2)_{11}NH_3Cl$ per 100 gms. Aq. Solvent at: 0°	20°	40°	60°
0.0 (=H_2O)	0.1	0.2	60	74
10.	0.2	3.1	79	110
20	0.3	11.5	128	185
40	0.9	33.8	238	685
60	3.8	38.7	166	490
80	5.6	24.1	93	295
93.5	2.7	12.6	53	175
99.9	0.2	6.5	34	113

The published paper gives the results only in the form of a diagram. The above numerical values were kindly supplied by the authors.

DODECYL AMMONIUM SALTS $CH_3(CH_2)_{11}NH_3Cl$ etc.

SOLUBILITY OF DODECYL AMMONIUM SALTS IN WATER

(Hoerr and Ralston, 1942)

Salt	Gms. Salt per 100 gms. H_2O at: 0°	20°	40°	60°	80°	100°
Dodecyl Ammonium Chloride	0.1	0.3	60.1	74.2	86.4	98.4
Dodecyl Ammonium Bromide	-	0.3	56.0	79.0	103.	-
Dodecyl Ammonium Iodide	-	0.3	8.1	86.	119.	-
Dodecyl Ammonium Formate	26.7	30.5	34.7	39.5	47.2	127.
Dodecyl Ammonium Acetate	30.2	34.2	38.5	43.9	58.0	152.
Dodecyl Ammonium Propionate	21.7	36.4	129.	177.	∞	∞
Dodecyl Ammonium Monophosphate	-	-	-	0.6	-	-

The published paper gives the results only in the form of a diagram. The above numerical values were kindly supplied by the authors.

SOLUBILITY OF DODECYL AMMONIUM SALTS IN 95 Wt. % ETHYL ALCOHOL

(Broome and Harwood, 1950)

Salt	Gms. Salt per 100 gms. 95 Wt. % C_2H_5OH at:			
	10°	30°	50°	70°
Dodecyl Ammonium Chloride	6.7	23.3	93.0	245
Dodecyl Ammonium Bromide	10.4	47.0	146.	335
Dodecyl Ammonium Iodide	51.3	126.	350	560
Dodecyl Ammonium Formate	50.4	182	650	-
Dodecyl Ammonium Acetate	43.3	146	490	∞
Dodecyl Ammonium Propionate	53.6	210	1440	∞
Dodecyl Ammonium Butyrate	185.	835	∞	∞
Dodecyl Ammonium Monosulfate	5.6	28.5	235	-
Dodecyl Ammonium Monophosphate	-	-	0.3	4.2
Dodecyl Carbamate	-	4.3	50.4	-

The above numerical values were kindly supplied by the authors.

SOLUBILITY OF DODECYL AMMONIUM SALTS IN BENZENE

(Broome and Harwood, 1950)

Salt	Gms. Salt per 100 gms. C_6H_6 at:			
	10°	30°	50°	70°
Dodecyl Ammonium Chloride	-	-	1.5	54.1
Dodecyl Ammonium Bromide	-	0.4	6.4	92.7
Dodecyl Ammonium Iodide	-	2.9	80.8	143.
Dodecyl Ammonium Formate	-	9.4	270.	415.
Dodecyl Ammonium Acetate	-	2.0	140.	∞
Dodecyl Ammonium Propionate	1.5	43.5	710	∞
Dodecyl Ammonium Butyrate	43.0	710.	∞	∞
Dodecyl Carbamate	-	-	17.6	225

The above numerical values were kindly supplied by the authors.

METHYL DODECYL AMMONIUM SALTS $CH_3(CH_2)_{11}NH_2(CH_3)Cl$ etc.

SOLUBILITY OF METHYL, DIMETHYL AND TRIMETHYL DODECYL AMMONIUM SALTS IN WATER

Salt	Gms. Salt per 100 gms. H_2O at:					
	0°	20°	40°	60°	80°	100°
Methyl Dodecyl Ammonium Chloride	0.2	13.6	40.4	46.1	55.0	66.5
Dimethyl Dodecyl Ammonium Chloride	56.2	59.0	61.8	64.8	68.5	73.9
Dimethyl Dodecyl Ammonium Acetate	67.2	73.9	81.2	93.2	∞	∞
Trimethyl Dodecyl Ammonium Chloride	74.2	70.4	69.8	70.2	72.7	95.9

The above unpublished numerical values were kindly supplied by Messrs. Hoerr and Ralston.

Results for the freezing-points of mixtures of Dodecyl Ammonium Acetate and Water and for the liquidus curves of Dodecyl Ammonium Formate, Acetate, Propionate and N-Dimethyl Ammonium Acetate in water, are given in the form of diagrams by Hoerr and Ralston, 1942.

DODECANE $CH_3(CH_2)_{10}CH_3$

SOLUBILITY OF n DODECANE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Crews, 1944)

t°	Gms. $CH_3(CH_2)_{10}CH_3$ per 100 gms. Solvent in: Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Ethyl Acetate	Butyl Acetate
-60	-	0.5	0.9	-	0.3
-50	-	1.3	3.4	-	0.9
-40	-	4.9	10.0	0.3	2.6
-30	-	19.8	39.1	2.8	7.4
-20	114	117.	186.	13.6	84.6
-15	260	317.	490.	106.0	178.0

t°	Gms. $CH_3(CH_2)_{10}CH_3$ per 100 gms. Solvent in: Acetone	2-Butanone	Isopropanol	n Butanol
-60	-	0.4	-	0.5
-50	-	0.7	0.1	1.0
-40	0.5	1.3	0.7	2.0
-30	1.2	3.2	2.7	4.6
-20	3.3	12.0	9.0	13.6
-15	6.2	41.8	21.1	31.4

THE EUTECTICS OF MIXTURES OF DODECANE AND OTHER COMPOUNDS
(Ralston, Hoerr, and Crews, 1944)

Mixture	Eutectic Temp.	Wt. % Dodecane
Dodecane + Benzene	-17.9	65.1
Dodecane + Cyclohexane	-32.9	28.5
Dodecane + Tetra Chloro Methane	-34.2	9.9
Dodecane + Trichloro Methane	-63.6	0.3

The critical solution temperature of mixtures of Dodecane and Aniline is 83.7°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931)

SOLUBILITY OF DODECANE AND SEVERAL OF ITS DERIVATIVES IN AQUEOUS SOLUTIONS OF 0.3 MOL. SODIUM LAURYL SULFATE PER 1000 GMS. DETERGENT SOLUTION AT 25° (?)
(Harkins and Oppenheimer, 1948, 1949)

Compound	Compound per 1000 gms. Aqueous Solvent: Gms.	Mols.
Dodecane $CH_3(CH_2)_{10}CH_3$	< 1.72	< 0.01
Dodecyl Chloride $CH_3(CH_2)_{11}Cl$	< 1.82	< 0.01
Dodecyl Mercaptan $CH_3(CH_2)_{11}SH$	6.55	0.03
Dodecyl Amine $CH_3(CH_2)_{11}NH_2$	20.6	0.11
Dodecyl Alcohol $CH_3(CH_2)_{11}OH$	22.8	0.12
Dodecylic Acid $CH_3(CH_2)_{10}COOH$	26.3	0.13

A distinction is drawn by the authors between solubilization and film penetration.

SOLUBILITY OF DODECYL SALTS, EACH SEPARATELY, IN WATER

(Adam and Pankhurst, 1946)

Note. In the case of these salts the solubility below a certain temperature is small but above this temperature it increases extremely rapidly with small increments of temperature. The results are given only in the form of a diagram from which the following approximate values were estimated. For the determinations, weighed amounts of the salt and water were sealed in pyrex tubes and the temperatures determined at which a clear solution was obtained on slow warming.

Results for:

Dodecyl Pyridinium Bromide		Dodecyl Pyridinium Iodide		Dodecyl Sodium Sulfate	
t°	Gms. $CH_3(CH_2)_{11}NC_6H_4Cl$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_{11}NC_6H_4I$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_{11}OSO_3Na$ per 100 gms. H_2O*
0.0	0.22	10	0.10	15	0.1
2.5	0.66	20	0.33	16	0.5
2.7	1.0	22.2	2.0	17	1.0
3.0	2.0	22.3	4.0	17.5	2.0
3.8	8.0	22.5	8.0	18.0	8.0
4.2	10.0	22.6	10.0	18.3	10.0

*In this case the solvent was Aqueous 0.05 n Na_2CO_3 instead of H_2O.

DODECANOL $CH_3(CH_2)_{10}CH_2OH$

SOLUBILITY OF DODECANOL IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{10}CH_2OH$ per 100 gms. Solvent in:			
	Benzene	Cyclohexane	Nitro Ethane	Acetonitrile
0	-	-	0.9	1.0
10	139	125	4.2	3.9
20	1390	1290	20.2	16.7
30	∞	∞	∞	29.9

t°	Gms. $CH_3(CH_2)_{10}CH_2OH$ per 100 gms. Solvent in:				
	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanol
-20	1.3	2.7	5.5	1.6	3.7
0	18.9	16.1	21.8	12.9	19.6
+10	83.	76.0	84.0	75.0	88.
20	450	980.	980.0	1150.	1150.
30	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{10}CH_2OH$ per 100 gms. Solvent in:					
	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Isopropanol	n Butanol
-40	1.3	1.4	0.5	0.6	1.5	3.6
-20	4.1	5.3	3.0	4.2	10.0	11.3
0	47.5	44.2	73.0	52.0	72.	63.
+20	820.	960.	2340.	2120.	1330.	950.
30	∞	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF DODECANOL AND OTHER COMPOUNDS

Mixture	t°	Gms. Dodecanol per 100 gms. Mixture
Dodecanol + Benzene	2.5	23.9
Dodecanol + Cyclohexane	-0.9	15.8
Dodecanol + Tetra Chloro Methane	-23.3	1.1

DODECYL AMINE $CH_3(CH_2)_{10}CH_2NH_2$

The temperature-composition relations in the system Dodecyl Amine-Water are presented by Ralston, Hoerr, and Hoffman, 1942, in the form of a diagram which shows the transition temperatures and boundaries of the several liquid and solid phases, but from which accurate numerical values cannot be deduced. Three hydrates having the compositions $(C_{12}H_{25}NH_2)_3 \cdot 2H_2O$, $C_{12}H_{25}NH_2 \cdot 2H_2O$ and $C_{12}H_{25}NH_2 \cdot 4H_2O$ are formed.

SOLUBILITY OF DODECYL AMINE IN SEVERAL SOLVENTS

(Ralston, Hoerr, Pool, and Harwood, 1944)

t°	Gms. $CH_3(CH_2)_{10}CH_2 \cdot NH_2$ per 100 gms. Solvent in: Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether
-40	4.8	2.0	4.7	2.4	-	9.2	0.2
-20	29.7	14.1	15.0	8.5	5.5	20.0	3.4
0	196.	115.	75.0	57.0	19.8	56.0	22.6
+20	930.	660.	492.0	430.0	148.0	315.	275.
30	∞	∞	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{10}CH_2NH_2$ per 100 gms. Solvent in: Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile	Benzene	Cyclo-hexane
-20	4.7	4.4	0.3	3.6	-	-	-
0	18.6	23.0	8.1	18.6	0.2	-	-
+10	-	-	-	-	-	72.	57.
20	221.	221.	226.	290.	27.7	277.	230.
30	∞	∞	∞	∞	∞	∞	∞

THE EUTECTIC MIXTURES OF DODECYL AMINE AND OTHER COMPOUNDS

Mixture	t°	Wt. % $CH_3(CH_2)_{10}CH_2NH_2$
Amine + Benzene	+0.2	18.0
" + Cyclohexane	-3.5	8.3
" + Tetra Chloro Methane	-24.4	4.4

DODECYL AMINE HYDROCHLORIDE $CH_3(CH_2)_{10}CH_2NH_2 \cdot HCl$

Results for the solubility of Dodecyl Amine Hydrochloride in 95 Wt. % Ethyl Alcohol at temperatures between 10° and 70° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

DODECYL AMINE ACETATE $CH_3(CH_2)_{10}CH_2NH_2 \cdot CH_3COOH$

The temperature-concentration relations in the system Dodecyl Amine Acetate-Water is presented by Ralston, Hoerr, and Hoffman, 1941, in the form of a diagram which shows the transition points and boundaries of the several liquid and solid phases. No evidence of compound formation was obtained.

Results for the solubility of Dodecyl Amine Acetate in 95 Wt. % Ethyl Alcohol and in Benzene, between about 10° and 50°, are given in the form of diagrams by Norwood, Ralston, and Selby, 1941.

DICHLORO FLUORENE $C_{13}H_8Cl_2$

SOLUBILITY OF DICHLORO FLUORENE IN SEVERAL SOLVENTS
(Albertson and Ray, 1949)

t°	Gms. $C_{13}H_8Cl_2$ per 100 cc Solvent in:					
	n Butanol	Acetic Acid	Dioxane	Toluene	Kerosene	2-Pentanone
0	-	-	-	21.5	-	29.0
10	-	4.8	41.5	31.0	-	35.5
20	-	6.6	53.7	42.5	7.0	43.0
30	8.0	9.1	70.0	58.0	9.0	53.7
40	9.6	12.7	96.0	76.5	14.0	70.5
50	12.7	18.4	-	100.(46.6°)	22.5	100.(47.6°)
60	19.2	29.6	-	-	34.5	-
70	33.3	53.0	-	-	53.5	-
80	80.(76.6°)	80.0(74.6°)	-	-	-	-

FLUORENONE $C_6H_4COC_6H_4$

SOLUBILITY OF FLUORENONE IN SEVERAL SOLVENTS
(Albertson and Ray, 1949)

t°	Gms. $C_{13}H_8O$ per 100 cc Solvent in:					
	n Butanol	Acetic Acid	Dioxane	Toluene	Kerosene	2-Pentanone
0	-	-	-	18.0	-	24.0
10	-	9.5	61.5	28.5	2.5	34.0
20	8.2	24.0	79.0	42.5	3.0	45.0
30	11.4	44.0	98.0(27.3°)	63.0	4.0	63.0
40	20.0	80.0	-	100.0	6.0	100.0(39.0°)
50	42.5	100.(41.6°)	-	-	9.4	-
60	90.0(56.6°)	-	-	-	17.6	-
					50.0(68°)	

FLUORENE $C_6H_4CH_2C_6H_4$

SOLUBILITY OF FLUORENE IN SEVERAL SOLVENTS
(Albertson and Ray, 1949)

t°	Gms. $C_{13}H_{10}$ per 100 cc Solvent in:					
	n Butanol	Acetic Acid	Dioxane	Toluene	Kerosene	2-Pentanone
0	-	-	-	9.0	-	11.6
10	2.7	2.0	21.0	12.8	3.7	14.4
20	3.0	2.5	27.8	18.5	5.0	18.0
30	4.0	3.8	36.0	26.2	7.2	23.2
40	5.5	5.7	46.5	35.7	10.0	30.5
50	7.8	8.7	62.0	50.0	14.0	43.0
60	11.5	13.7	90. (57.3°)	73.5	19.8	62.5
70	18.0	22.5	-	95.0 (66.8°)	30.6	100. (67.°)
80	32.5	37.0	-	-	50.0	-
90	80.0 (88°)	70.0	-	-	70.0 (85°)	-

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF FLUORENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Ethylene Glycol	220	Ethanol Amine	145
Triethanol Amine	180	Diethylene Glycol	138
Diethanol Amine	179	Resorcinol	105

Freezing-point data are given for:

Fluorene + Acenaphthene (Klochko-Zhovnir, 1948)
Fluorene + Phenanthrene " " "
Fluorene + Fluoranthene (Klochko-Zhovnir, 1949)

2 - AMINO FLUORENE $C_6H_4CH_2C_6H_3NH_2$

SOLUBILITY OF 2-AMINO FLUORENE IN AQUEOUS PURINE SOLUTIONS
(Neish, 1948)

The solutions were shaken frequently at 37° for 5 hours and then allowed to stand at room temperature for one hour before filtering. The Amine content of the clear solution was determined by a colorimetric diazotization procedure.

Gms. Amine per 100 cc Aq. Solution	Milligrams $C_{13}H_{11}N$ Dissolved per liter Aqueous Solution of: (1)	(2)	(3)	(4)	(5)	(6)	(7)
0.0(=H_2O)	0.033	0.024	0.031	0.025	0.037	0.022	0.025
0.10	0.075	0.056	0.089	0.052	0.055	-	-
0.15	-	-	0.093	0.083	0.064	-	-
0.25	0.208	-	0.140	-	-	0.027	-
0.3	-	0.176	-	0.133	0.107	-	-
0.35	-	-	0.163	-	-	-	-
0.4	-	0.231	-	0.182	0.122	-	-
0.5	0.348	0.339	0.193	-	0.120	0.039	0.046
0.7	0.363	-	-	-	-	-	-
1.0	0.528	-	0.279	-	-	0.114	0.056
2.0	-	-	-	-	-	-	0.101

(1) 1,3,7,9 Tetra Methyl Uric Acid
(2) 1,3,7 Trimethyl Uric Acid
(3) 1,3,7 Trimethyl Xanthine
(4) 8 - Methoxy Caffeine
(5) Theophylline
(6) Adenosine (-R'=ribose)
(7) Mg Adenosine Triphosphate (-R''=Ribose Triphosphate)

SOLUBILITY OF 2-AMINO FLUORENE IN AQUEOUS SOLUTIONS OF MIXTURES OF CAFFEINE AND 1,3,7 TRIMETHYL URIC ACID

(Neish, 1948)

Gms. Purine per 1 cc Aqueous Solution: Caffeine	1,3,7 Trimethyl Uric Acid	Milligms. $C_{13}H_{11}N$ Dissolved per liter Aqueous Solution
0.5	0.25	0.249
0.4	0.20	0.256
0.3	0.15	0.097
0.2	0.10	0.047
0.1	0.05	0.024
1.0	-	0.247
-	0.5	0.270

ISOPROPYL NAPHTHALENE $C_{10}H_7(CH_3)_2CH$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF ISOPROPYL NAPHTHALENE AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Triethanol Amine	226	Triethylene Glycol	133
Diethanol Amine	217	Benzidine	103
p Amino Acetanilide	220	Ethylene Diformate	76
Hydroquinone	198	Maleic Anhydride	< 40
Ethanol Amine	168	p Amino Ethyl Acetanilide	< 57
Adipic Acid	184	Nitro Methane	-2
Diethylene Glycol	175	Methanol	11
Resorcinol	153	Acetonitrile	-30
p Phenylene Diamine	140	Acetic Anhydride	< -78

PYRAMIDON (Dimethyl Amino Antipyrine) $(C_{11}H_{11}N_2O)\cdot N(CH_3)_2$

SOLUBILITY OF PYRAMIDON IN WATER
(Kaplan and Rabinovich, 1948)

t°	Gms. $C_{13}H_{17}N_3O$ per 100 gms. Sat. Sol.	t°	Gms. $C_{13}H_{17}N_3O$ per 100 gms. Sat. Sol.
0.0	1.9	50	5.0
1.0	2.7	60	7.7
4.0	3.9	70	16.2
10.0	4.6	75	72.0
20.	4.7	80	82.0
30	4.8	90	88.2
40	4.9	100	92.0

At 73° and concentrations between 21 and 68.6 percent Pyramidon, the system separates into two liquid layers, the limiting curve of which is a complete circle.

Upper Layer		Lower Layer	
t°	Gms. $C_{13}H_{17}N_3O$ per 100 gms. Sat. Sol.	t°	Gms. $C_{13}H_{17}N_3O$ per 100 gms. Sat. Sol.
123	9.38	129	10
104	10.0	166	15
81	15.0	175	20
77	20.0	190	45
70.5	27.0	188	50
70.0	40.0	175	66.6
69.5	50	152	75.
74.4	66.6	138	77.7
84.	75.		
92	77.7		

The distribution coefficient of Pyramidon between Ethyl Ether and Water, for a concentration of 130 millimols per liter in the ether layer divided by 205 millimols per liter in the water layer is 0.63 at 20°. (Collander, 1949).

ISOPROPYL TETRALIN $C_{10}H_{11}(CH_3)_2CH$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF ISOPROPYL TETRALIN AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Triethanol Amine	264	p Amino Ethyl Acetanilide	70
Diethanol Amine	248	Methyl Sulfate	57
Hydroquinone	235	Phenyl Ethanol Amine	10
Diethylene Glycol	210	Nitro Methane	34
Triethylene Glycol	179	Methanol	57
Benzidine	145	Furfuryl Alcohol	32
p Nitro Aniline	< 140	Phenyl Hydrazine	< 0
o Nitro Benzoic Acid	< 132	Acetonitrile	14
p Amino Acetophenone	102	Ethylene Chlorohydrin	-27
Ethylene Diformate	112	Acetic Anhydride	3
Salicyl Alcohol	83	Ethylene Diacetate	-21
Maleic Anhydride	110		

SALICIN $C_6H_{11}O_5OC_6H_4CH_2OH$

The distribution coefficient of Salicin between Ethyl Ether and Water, $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ for a concentration of about 200 millimols per liter in the water layer is 0.00049 at 19°. (Collander, 1949).

METHYL DIISOPROPYL BENZENE $C_6H_3CH_3[(CH_3)_2CH]_2$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF METHYL DIISOPROPYL BENZENE AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	229	m Dinitro Benzene	69
Triethylene Glycol	203	Nitro Methane	34
p Nitro Aniline	190	Methanol	32
o Nitro Benzoic Acid	168	Furfural Alcohol	32
Ethylene Diformate	131	Phenyl Hydrazine	40
Salicyl Alcohol	142	Acetonitrile	2
Maleic Anhydride	139	Ethylene Dichlorohydrin	13
m Nitro Phenol	115	Furfural	-18
p Amino Ethyl Acetanilide	113	Phenyl Phthalate	30
Catechol	100	Acetic Anhydride	-6
Methyl Sulfate	49	Ethylene Diacetate	-14

NOVOCAIN (Procaine) $NH_2C_6H_4COOC_2H_4N(C_2H_5)_2$

The distribution coefficient of Novocain between Ethyl Ether and Water, $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ is 64 at about 20°. (Collander, 1949, quoted from Eisenbrandt and Picher, 1938).

NOVOCAIN BICHROMATE $(C_{13}H_{20}N_2O_2)_2 \cdot H_2CrO_4$

SOLUBILITY OF NOVOCAIN BICHROMATE IN WATER

(Holleman and Bongenburg de Jong, 1940)

Note. In this system separation into two liquid layers occurs at a given temperature. Except for the triple and melting points, the results are given only in the form of a diagram from which the following approximate values were read.

t°	Gms. $(C_{13}H_{20}N_2O_2)_2 \cdot H_2CrO_4$ per 100 gms. Sat. Sol.
63	1.0
70	3.0
74 (tr.pt.)	9.0
74 "	74.0
84	81
100	90
133.5 (m.pt.)	100.

Liquid Layer Results

t°	Gms. $(C_{13}H_{20}N_2O_2)_2H_2CrO_4$ per 100 gms.	
	H_2O rich Layer	Novocain Salt rich layer
74	9	74
80	10	71
90	18	62.5
99 (Crit.t.)	40.	

NOVOCAIN PERCHLORATE $C_{13}H_{20}N_2O_2 \cdot HClO_4$

SOLUBILITY OF NOVOCAIN PERCHLORATE IN WATER
(Holleman and Bongenburg de Jong, 1940)

See Note under NOVOCAIN BICHROMATE

t°	Gms. $C_{13}H_{20}N_2O_2 \cdot HClO_4$ per 100 gms. Sat. Sol.
36	1.0
51	5.0
56(tr.pt.)	12.0
56 "	78.0
60	80.
70	87.
80	91
112(m.pt.)	100

Liquid Layer Results

t°	Gms. $C_{13}H_{20}N_2O_2 \cdot HClO_4$ per 100 gms.	
	H_2O rich Layer	Novocain Salt Rich Layer
56	12.0	78.0
60	13.0	76.0
70	19.0	70.0
75	23.0	62.
78 Crit.t.	43.0	

NOVOCAIN THIOCYANATE $C_{13}H_{20}N_2O_2 \cdot HCNS$

SOLUBILITY OF NOVOCAIN THIOCYANATE IN WATER
(Holleman and Bongenburg de Jong, 1940)

See Note above.

t°	Gms. $C_{13}H_{20}N_2O_2 \cdot HCNS$ per 100 gms. Sat. Sol.
34.5	2.0
36.(tr.pt.)	10.
36. "	70.
40.	70.5
50	72
60	80
70	88
80(m.pt.)	100

Liquid Layer Results

t°	Gms. $C_{13}H_{20}N_2O_2 \cdot HCNS$ per 100 gms.	
36	H_2O Rich Layer	Novocain Salt Rich Layer
36	10.0	70.0
40	11.	68.
45	14.	65.
50	20	60
54 Crit.temp.	40.0	

NOVOCAIN IODIDE $C_{13}H_{20}N_2O_2 \cdot HI$

SOLUBILITY OF NOVOCAIN IODIDE IN WATER
(Holleman and Bongenburg de Jong, 1940)

The original results are given only in the form of a diagram from which the following values were read.

t°	Gms. $C_{13}H_{20}N_2O_2 \cdot HI$ per 100 gms. Sat. Sol.
27.0	9.0
30.5	20.0
32.0	40.0
34.0	60.0
36.	70.0
41.	80.0
49.	82.0

PENTA ERYTHRITE TETRA ACETATE $C_{13}H_{20}O_8$

The distribution coefficient of Penta Erythrite Tetra Acetate between Ethyl Ether and Water, for a concentration of 294 millimols per liter in the ether layer divided by 31.6 millimols per liter in the water layer is 9.3 at 20°. (Collander, 1949).

TRIDECYLIC ACID (Tridecanoic Acid) $CH_3(CH_2)_{11}COOH$

SOLUBILITY OF TRIDECYLIC ACID IN SEVERAL SOLVENTS
(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{11}COOH$ per 100 gms. Solvent in:					
	Water	95 Wt. % Ethanol	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	0.0021	15.5	7.52	11.9	-	-
10	-	34.5	20.2	29.5	42.4	-
20	0.0033	104.	78.6	95.	117.	96.8
30	0.0038	336.	316.	315.	354.	395.
40	-	6560.	8230.	8230.	7600.	8230.
45	0.0044	-	-	-	-	-
50	-	∞	∞	∞	∞	
60	0.0054					

SOLUBILITY OF TRIDECYLIC ACID IN SEVERAL SOLVENTS
(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{11}COOH$ per 100 gms. Solvent in:				
	Cyclohexane	Tetrachloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	11.3	28.4	10.1	14.5
10	31.0	26.9	53.	22.5	33.0
20	100.	75.0	116.	70.	95.0
30	330.	240.	315.	281	322.
40	8200.	5450.	6550.	8200	9000.
50	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{11}COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	12.6	22.1	21.5	1.4	1.4
10	48.5	52.	39.8	2.1	2.0
20	148.	125.	100.	4.5	5.8
30	515.	340.	295.	17.3	21.4
40	14,000.	6550.	5750.	9000.	8600.
50	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF TRIDECYLIC ACID AND OTHER COMPOUNDS
(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{11}COOH$
Tridecylic Acid + Cyclohexane	1.9	8.6
Tridecylic Acid + Benzene	3.7	14.6
Tridecylic Acid + Glacial Acetic Acid	13.1	15.9

TRIDECANE $CH_3(CH_2)_{11}CH_3$

The critical solution temperature of mixtures of Tridecane and Aniline is 87°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

TRIDECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{12}NH_2 \cdot HCl$

Results for the solubility of Tridecylamine Hydrochloride in 95 Wt. % Ethanol at temperatures between 10° and 40° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

TRIDECYLAMINE ACETATE $CH_3(CH_2)_{12}NH_2 \cdot CH_3COOH$

Results for the solubility of Tridecylamine Acetate in 95 Wt. % Ethanol and in Benzene at temperatures between 10° and 50° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

PHENANTHRENE $C_{14}H_{10}$

The solubility of Phenanthrene in water determined fluorimetrically is 0.000015 mol. (0.0027 gm.) per liter at 20°. Results are also given for the influence of Caffeine, Tetramethyl Uric Acid and of Theophylline on the solubility of Phenanthrene in Water. (Weil-Malherbe, 1946).

THE CRITICAL SOLUTION TEMPERATURE OF MIXTURES OF PHENANTHRENE AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Ethylene Glycol	225	Ethanol Amine	139
Triethanol Amine	175	Diethylene Glycol	128
Diethanol Amine	182	Monoacetin	130
Glycerol Monochloro Hydrin	174	Resorcinol	111

Freezing-point data are given by Klochko-Zhovnir, 1949 for:

Phenanthrene + Fluoranthene
Phenanthrene + Naphthalene

ANTHRACENE $C_6H_4:(CH)_2:C_6H_4$

The solubility of Anthracene in Water determined fluorimetrically is 0.0000005 mol. (0.000089 gm.) per liter at 20°. Results are also given for the influence of Caffeine, Tetramethyl Uric Acid and Theophylline on the solubility of Anthracene in Water. (Weil-Malherbe, 1946).

THE SOLUBILITY OF ANTHRACENE AND OTHER CARCINOGENIC HYDROCARBONS IN WATER AT 27°

(Davis, Krabl, and Clowes, 1942)

The determinations were made by the nephelometric method, and the results are expressed in terms of micrograms ($=10^6$ gm.) per liter. A description of the nephelometric and the results in parentheses are given by Davis and Parke, Jr., 1942.

Hydrocarbon	Micrograms Hydrocarbon per liter	Hydrocarbon	Micrograms Hydrocarbon per liter
Anthracene	75.	Triphenylene	38.
Phenanthrene	1600.(1650)	Pyrene	165.
Naphthalene	1.0	4, 5 Methylene Phenanthrene	1100.
Chrysene	1.5	Perylene	< 0.5
5-Methyl Chrysene	62.	1, 2, 5, 6, Dibenzanthracene	0.5
6-Methyl Chrysene	65.	Picene	2.5
5, 6-Dimethyl Chrysene	25.	3, 4^1-Ace 1, 2-Benzanthracene	2.7
1, 2-Benzanthracene	11.	Cholanthrene	3.5
1 Methyl, 1, 2-Benzanthracene	55.	20-Methyl Cholanthrene	1.5
9 Methyl, 1, 2-Benzanthracene	44.	3,4 Benzpyrene	4.0(4.0)
6 Chloro, 10-Methyl, 1, 2-Benzanthracene	10.	5-Methyl, 3, 4-Benzpyrene	0.8
10-Ethyl, 1, 2 Benzanthracene	45.(40)	1, 2, 7, 8 Dibenzanthracene	12.0
10 Butyl, 1, 2 Benzanthracene	8.	15, 16-Benzdehydro Cholanthrene	1.0
10 Amyl, 1, 2 Benzanthracene	0.8		
9, 10-Dimethyl, 1, 2 Benzanthracene	43.0		

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF ANTHRACENE AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture
Ethylene Glycol	217
Triethanol Amine	< 197
Diethanol Amine	< 195

DICHLORO, DIPHENYL TRICHLORO ETHANE (DDT) $C_2Cl_3(C_6H_5Cl)_2$

SOLUBILITY OF DICHLORO, DIPHENYL TRICHLORO ETHANE IN SEVERAL SOLVENTS

(Gunther, 1945)

t°	Gms. $C_2Cl_3(C_6H_5Cl)_2$ per 100 gms. Saturated Solution in:				
	Acetone	Benzene	Carbon Tetrachloride	Chloroform	Dioxane
0	21.2	6.8	9.0	18.2	8.0
7.2	27.3	27.1	10.5	21.9	29.0
24.0	40.3	44.0	18.0	31.0	46.0
45.	-	-	34.8	47.4	-
48.	59.0	57.8	-	-	61.0

t°	Gms. $C_2Cl_3(C_6H_5Cl)_2$ per 100 gms. Saturated Solution in:			
	Ethyl Ether	95% Ethanol	Petroleum Ether	Pyridine
0	15.0	0.8	1.7	21.0
7.2	18.9	1.0	2.4	36.0
24.0	27.5	2.2	4.8	51.0
45.	-	-	-	-
48.	-	3.9	-	62.0

Mention is made that commercial DDT contains the o, p' Isomer and other contaminants which would give rise to solubility results differing from those obtained with the pure compound.

For the determination of impurities in DDT, Thorp, 1946, describes a solubility procedure for this purpose, based upon dissolving successive amounts of the sample in petroleum ether, ethyl alcohol, chloro benzene, carbon tetrachloride and benzene. From the diagrams plotted from such results, estimates of the impurities can be made.

SOLUBILITY OF DICHLORO DIPHENYL TRICHLORO ETHANE (PURE DDT) IN SEVERAL SOLVENTS

(Fleck and Haller, 1946)

Solvent	Gms. $C_2Cl_3(C_6H_5Cl)_2$ per 100 gms. Solvent	Solvent	Gms. $C_2Cl_3(C_6H_5Cl)_2$ per 100 gms. Solvent
Amsco Solvent G (1)	40	Solvent P D 544B (1)	45
Aro-Sol (151-B)(1)	49	Solvent PD 544C (1)	39
Benzene	85	Solvesso NO 1 (2)	52
Deobase (2)	6	Solvesso No 2 (2)	50
Diisopropyl Benzene	22	Solvesso No 3 (2)	40
Heavy Aromatic Naphtha (1)	48	Toluene	80
Culicide Oil (1)	48	Ultrasene (2)	6
Methyl Ethyl Ketone	100	Velsicol AR-50 (1)	53
Monomethyl Naphthalene	63	Velsicol AR-60 (1)	49
Solvent PD 544A (1)	40	Xylene	64

(1) An Alkylated Naphthalene fraction
(2) A Petroleum fraction

SOLUBILITY OF TECHNICAL AND PURE DDT, EACH SEPARATELY, IN KEROSENES

(Fleck and Haller, 1946)

t°	Gms. DDT (Technical and Pure) per 100 gms.:							
	Kerosene A (1) (An. Pt. 48.1°)		Kerosene B (2) (An. Pt. 70.4°)		Kerosene C (3) (An. Pt. 63.0°)		Kerosene C (An. Pt. 69.1°)	
	Technical	Pure	Technical	Pure	Technical	Pure	Technical	Pure
-30	3	2	1	0.5	3	1	2	1
-20	4	3	2	1	4	2	2	2
0	7	5	4	3	4	3	4	3
+20	12	9	8	6	9	8	8	6
30	20	12	11	8	16	12	13	8

Gms. DDT (Technical and Pure) per 100 gms.:

t°	Kerosene E (An. Pt. 67.3°)		Kerosene F (An. Pt. 67.3°)		Kerosene G (An. Pt. 63.5°)	
	Technical	Pure	Technical	Pure	Technical	Pure
-30	2	1	2	1	2	1
-20	3	2	3	2	3	2
0	5	3	5	3	6	4
+20	9	7	9	7	10	8
30	15	10	15	10	17	11

An. Pt. = Aniline Point

(1) Naphthenic Source (2) Paraffine Source (3) Mid Continent Source

DIBENZYL $C_6H_5CH_2CH_2C_6H_5$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIBENZYL AND SEVERAL SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Triethanol Amine	215	Adipic Acid	< 147
Diethanol Amine	206	Diethylene Glycol	160
Acetamide	185	Monoacetin	140
Glycerol Monochlorohydrin	178	Resorcinol	125
Hydroquinone	171	Triethylene Glycol	115
Ethanol Amine	168		

p DIMETHYL AMINO AZOBENZENE $C_{14}H_{15}N_3$

Results showing the solubilization of p Dimethyl Amino Azobenzene in aqueous solutions of potassium and of sodium salts of oleic, lauric, palmitic, etc., acids, in terms of the milligrams of the compound solubilized per mol. of micellized soap, are given by Kolthoff and Johnson, 1946.

BORNYL FUMARATE $CO_2HCH{:}CHCO_2C_{10}H_{17}$

Freezing-point data for mixtures of the various racemic and optically active isomers of Bornyl Fumarate are given by Abbot, McKenzie, and Ross, 1937.

TETRAETHYL BENZENES (Sym. and Unsym.) $C_6H_2(C_2H_5)_4$

Freezing-point data for mixtures of Sym.and Unsym. Tetraethyl Benzenes are given by Smith and Gus, 1940.

MYRISTONITRILE $CH_3(CH_2)_{12}CN$

SOLUBILITY OF MYRISTONITRILE IN SEVERAL SOLVENTS
(Hoerr, Binkerd, Pool, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{12}CN$ per 100 gms. Solvent in: Benzene	Cyclohexane	Tetrachloro Methane	Trichloro Methane	Ethyl Ether
-40	-	-	-	14.4	2.6
-20	-	-	5.1	34.6	11.0
0	-	-	52.	107.	60.
+10	318	245	155.	260.	175.
20	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{12}CN$ per 100 gms. Solvent in: Ethyl Acetate	Butyl Acetate	Acetone	n Butanone	Methanol
-40	1.6	2.8	1.8	3.5	1.0
-20	5.5	7.0	4.2	10.0	1.4
0	55.	42.8	63.	76.	5.8
+10	225.	174.	239.	272.	41.4
20	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{12}CN$ per 100 gms. Solvent in: 95 Wt. % Ethanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
-40	1.2	1.5	1.7	1.0	0.1
-20	2.2	2.3	3.0	3.1	1.1
0	8.7	9.7	13.2	32.7	9.6
+10	59.	67.	83.	207.	258.
20	∞	∞	∞	∞	∞

THE EUTECTIC TEMPERATURES AND COMPOSITIONS OF MIXTURES OF MYRISTONITRILE AND OTHER COMPOUNDS
(Hoerr, Binkerd, Pool, and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{10}CN$
Myristonitrile + Benzene	-7.6	39.0
Myristonitrile + Cyclohexane	-5.2	12.1
Myristonitrile + Trichloro Methane	-23.8	2.1
Myristonitrile + Glacial Acetic Acid	+8.8	50.4

MYRISTIC ACID (Tetradecanoic Acid) $CH_3(CH_2)_{12}COOH$

SOLUBILITY OF MYRISTIC ACID IN WATER

(Ralston and Hoerr, 1942; Eggenberger, Broome, Ralston, and Harwood, 1949)

t°	Gms. $CH_3(CH_2)_{12}COOH$ per 100 cc Sat. Sol.	Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_{12}COOH$ per 100 cc Sat. Sol.	Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. H_2O
0	-	0.0013	45	-	0.0029
20	-	0.0020	50	0.00042	-
30	-	0.0024	60	0.00056	0.0034

The authors give no explanation of the divergence of the above results.

SOLUBILITY OF MYRISTIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. Solvent in:

t°	95% Ethanol	99.4% Ethanol	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	3.86	7.07	2.75	4.28	-	-
10	7.64	9.77	6.50	8.46	6.95	-
20	18.9	23.9	15.9	18.5	29.2	10.2
30	68.7	84.7	42.5	54.3	87.4	51.1
40	238.0	263.	149.	189.	239.	289.
50	1485.	1560.	∞ (56.5°)	1230.	1290.	1410.
60	∞	∞		∞	∞	∞

SOLUBILITY OF MYRISTIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. Solvent in:

t°	Cyclohexane	Tetrachloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	3.2	8.1	3.4	4.8
10	5.3	6.8	15.1	6.6	9.9
20	21.5	17.6	32.5	15.3	21.6
30	72.	55.	78.	44.7	61.
40	217.	106.	205	164.	208.
50	1310	870.	1000.	1350.	1370
60	∞	∞	∞	∞	∞

Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. Solvent in:

t°	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	2.8	7.2	7.3	0.3	0.7
10	5.8	13.6	13.1	0.5	0.9
20	17.3	31.6	28.7	1.2	1.8
30	75.0	82.	71.	3.3	4.1
40	350.	230.	194.	10.7	13.0
50	2670.	1210.	980.	1180.0	1210.
60	∞	∞	∞	∞	∞

$C_{14}H_{28}O_2$

THE EUTECTICS OF MIXTURES OF MYRISTIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{12}COOH$
Myristic Acid + Cyclohexane	5.6	2.4
Myristic Acid + Benzene	5.2	2.88
Myristic Acid + Glacial Acetic Acid	15.18	5.3

SOLUBILITY OF MYRISTIC ACID IN SEVERAL SOLVENTS

(Hoerr, Sedgwick, and Ralston, 1946)

t°	Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. Solvent in:			
	Toluene	o Xylene	Chlorobenzene	Furfural
-10	0.6	0.3	0.4	-
0	3.2	2.4	2.0	-
+10	10.2	8.4	7.2	-
20	30.4	26.1	23.6	-
30	82.1	75.4	72.4	1.5
40	230.	221.	220.	13.6
50	1350.	1320.	1280.	792.0

t°	Gms. $CH_3(CH_2)_{12}COOH$ per 100 gms. Solvent in:			
	Nitro Benzene	1, 4 Dioxane	1, 2 Dichloro Ethane	Nitro Methane
0	-	-	-	-
10	1.3	-	0.8	-
20	3.0	32.6	5.0	0.7
30	7.1	88.	35.5	1.3
40	34.2	228.	164.	2.3
50	560.	1100	1150.	4.7
60	∞	∞	∞	7.1
70	-	-	-	11.1
80	-	-	-	19.2

Freezing-point data for mixtures of Myristic Acid and Palmitin are given by Efremov, Vinogradova, and Tichomirova, 1937.

MYRISTAMIDE (Tetradecanamide) $CH_3(CH_2)_{12}CONH_2$

SOLUBILITY OF MYRISTAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

t°	Gms. $CH_3(CH_2)_{12}CONH_2$ per 100 gms. Solvent in:					
	Benzene	Cyclo-hexane	Tetrachloro Methane	Ethyl Acetate	2-Butanone	Acetone
10	0.3	-	-	0.3	0.6	0.4
30	0.4	0.2	< 0.1	1.0	1.2	1.0
50	1.5	0.3	0.2	3.3	4.7	3.7
60	5.2	0.4	1.4	7.8	11.1	6.4 (56.5°)
70	27.4	1.7	10.1	22.1	32.8	-
80	95.0	61. (81.4°)	27.6 (76.0°)	55.0 (77.2°)	100.0 (79.6°)	-

t°	Gms. $CH_3(CH_2)_{12}CONH_2$ per 100 gms. Solvent in:						
	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	0.3	1.0	1.2	1.2	0.8	0.3	0.2
30	1.2	2.7	3.8	3.2	3.8	0.5	0.6
50	5.0	14.3	15.1	15.5	13.7	2.0	1.1
60	-	36.8	33.5	34.2	-	-	2.9
70	22.4	56. (64.7°)	81.0	76.0	58.0	7.5	7.8
90	165.0	-	180. (78.5°)	208. (82.3°)	276.0	142.0	43.3 (82.0°)
100	700.0	-	-	-	1150.0	1500.	-

TETRADECANE $CH_3(CH_2)_{12}CH_3$

The critical solution temperature of mixtures of Tetradecane and Aniline is 89.5°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

TETRADECANOL $CH_3(CH_2)_{12}CH_2OH$

SOLUBILITY OF TETRADECANOL IN SEVERAL SOLVENTS

Hoerr, Harwood, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{12}CH_2OH$ per 100 gms. Solvent in:			
	Benzene	Cyclohexane	Nitro Ethane	Acetonitrile
10	14.2	13.4	< 0.1	< 0.1
20	74.	72.	1.9	1.3
30	355	350	14.5	7.7
40	∞	∞	∞	22.1
50	-	-	-	∞

t°	Gms. $CH_3(CH_2)_{12}CH_2OH$ per 100 gms. Solvent in:				
	Tetrachloro Methane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone
-20	0.2	0.1	1.1	0.1	0.6
0	2.0	3.4	6.2	2.4	4.7
+10	10.5	10.2	17.0	8.7	16.5
20	54.	41.5	58.	38.6	60.0
30	210.	272.0	276.	340.0	340.0
40	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{12}CH_2OH$ per 100 gms. Solvent in:					
	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-40	-	0.1	-	-	-	0.2
-20	0.6	1.2	0.2	0.4	1.2	2.3
0	8.2	9.3	4.6	6.4	12.8	14.0
20	85.0	100.	158.	105.	123.	105.
30	305.	380.	870.	630.	545.	365.
40	∞	1180.	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF TETRADECANOL AND OTHER COMPOUNDS

(Hoerr, Harwood, and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{12}CH_2OH$
Tetradecanol + Benzene	5.2	6.5
Tetradecanol + Cyclohexane	4.8	5.6
Tetradecanol + Tetrachloro Methane	-23.0	0.1

TETRA DECYLAMINE $CH_3(CH_2)_{12}CH_2NH_2$

SOLUBILITY OF TETRA DECYLAMINE IN SEVERAL SOLVENTS

(Ralston, Hoerr, Pool, and Harwood, 1944)

Gms. $CH_3(CH_2)_{12}CH_2NH_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
-20	-	-	1.7	1.4	-	0.2	-
0	-	-	7.8	9.7	0.1	2.8	-
+10	26.4	19.9	-	-	-	-	-
20	83.	68.	57.0	62.0	15.5	48.0	1.8
30	302.	268.	233.	233.	228.0	285.0	14.9
40	∞	∞	∞	∞	∞	∞	∞

Gms. $CH_3(CH_2)_{12}CH_2NH_2$ per 100 gms. Solvent in:

t°	Tetra-chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	Aceto-nitrile
-40	-	4.5	-	0.2	-	0.6	0.2
-20	2.3	11.2	0.2	2.8	1.5	3.7	2.4
0	7.7	29.5	5.8	62.	30.2	25.1	16.5
+20	56.	110.	71.	292.	218.	154.	130.
30	235.	308.	273.	770.	660.	458.	405.
40	∞	∞	705.	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF TETRADECYLAMINE AND OTHER COMPOUNDS

(Ralston, Hoerr, Pool, and Harwood, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{12}CH_2NH_2$
Tetradecylamine + Benzene	3.0	10.8
Tetradecylamine + Cyclohexane	0.8	5.5
Tetradecylamine + Tetrachloro Methane	-23.4	1.9

TETRADECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{12}CH_2NH_2 \cdot HCl$

Results for the solubility of Tetradecylamine Hydrochloride in 95 Wt. % Ethanol at temperatures between 10° and 70° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

TETRADECYLAMINE ACETATE $CH_3(CH_2)_{12}CH_2NH_2 \cdot CH_3COOH$

Results for the solubility of Tetradecylamine Acetate in 95 Wt. % Ethanol and in Benzene at temperatures between 10° and 60° are given in the form of diagrams by Harwood, Ralston, and Selby, 1941.

NEUTRAL RED BASE $C_{15}H_{16}N_4$

The distribution coefficient of Neutral Red Base between Ethyl Ether and Water $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ for a concentration of about 1 millimol per liter of the ether layer is 5.0 at 21°. (Collander, 1949).

sec. AMYL NAPHTHALENE $C_{10}H_7 \cdot C_5H_{11}$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF sec. AMYL NAPHTHALENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Triethanolamine	251	Methyl Sulfate	5
Diethanolamine	239	Nitro Methane	27
Hydroquinone	229	Methanol	49
Adipic Acid	237	Furfural Alcohol	0
Diethylene Glycol	199	Chloro Acetic Acid	< 33
Triethylene Glycol	160	Phenyl Hydrazine	< 0
p Nitro Aniline	< 135	Acetonitrile	4
Ethylene Diformate	110	Ethylene Chlorohydrin	< -78
Salicyl Alcohol	80	Acetic Anhydride	-39
Maleic Anhydride	90	Ethylene Diacetate	-60
p Aminoethyl Acetanilide	< 50		

SPARTEINE $C_{15}H_{26}N_2$

The distribution coefficient of Sparteine between Ethyl Ether and Water for a concentration of 104 millimols per liter of the ether layer divided by by 1.6 millimols per liter of the water layer is 65 at 20°. (Collander, 1949).

PENTADECYLIC ACID $CH_3(CH_2)_{13}COOH$

SOLUBILITY OF PENTADECYLIC ACID IN SEVERAL SOLVENTS
(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{13}COOH$ per 100 gms. Solvent in:					
	Water	95 Wt. % Ethanol	2-Butanone	Acetone	Benzene	Glacial Acetic Acid
0	0.00076	3.82	4.28	2.20	-	-
10	-	7.18	8.70	5.27	8.84	-
20	0.0012	19.50	20.2	13.8	36.2	8.76
30	0.0014	78.5	70.4	49.3	103.	62.
40	-	295.0	257.	183.0	295.	350.
45	0.0017	-	-	-	-	-
50	-	2460.	2530.	∞	2280.	2600.
60	0.0020	∞	∞		∞	∞

SOLUBILITY OF PENTADECYLIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{13}COOH$ per 100 gms. Solvent in:				
	Cyclohexane	Tetrachloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	3.8	9.5	2.8	4.5
10	6.8	8.4	17.7	6.2	9.7
20	27.1	22.2	38.1	15.4	22.3
30	88.	69.	91.	51.	66.0
40	277.	208.	246.	208.	253.
50	2460.	1560.	1750.	2370.	2460.
60	∞	∞	∞	∞	∞

t°	Gms. $CH_3(CH_2)_{13}COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	2.2	6.2	7.1	0.1	0.4
10	5.0	13.3	12.5	0.2	0.5
20	16.4	34.4	28.4	0.7	1.1
30	75.0	95.	74.0	2.4	2.9
40	400.	272.	220.	10.2	10.5
50	4400.	2070.	1680.	2460.	2460.
60	∞	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF PENTADECYLIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{13}COOH$
Pentadecylic Acid + Cyclohexane	5.4	2.9
Pentadecylic Acid + Benzene	5.15	3.65
Pentadecylic Acid + Glacial Acetic Acid	15.4	4.3

PENTADECANE $CH_3(CH_2)_{13}CH_3$

The critical solution temperature of mixtures of Pentadecane and Aniline is 92.0°. (Ludeman, 1940, quoted from Shepard, Henne, and Midgley, 1931).

PENTADECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{13}CH_2NH_2 \cdot HCl$

Results for the solubility of Pentadecylamine Hydrochloride in 95 Wt. % Ethanol, at temperatures between 10° and 70° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

PENTADECYLAMINE ACETATE $CH_3(CH_2)_{13}CH_2NH_2 \cdot CH_3COOH$

Results for the solubility of Pentadecylamine Acetate in 95 Wt. % Ethanol and in Benzene, at temperatures between 10° and 60° are given in the form of diagrams by Harwood, Ralston, and Selby, 1941.

DODECYL TRIMETHYL AMMONIUM CHLORIDE $CH_3(CH_2)_{11}N(CH_3)_3Cl$

SOLUBILITY OF DODECYL TRIMETHYL AMMONIUM CHLORIDE IN SEVERAL SOLVENTS

(Beck, Harwood, and Ralston, 1947)

t°	Gms. $CH_3(CH_2)_{11}N(CH_3)_3Cl$ per 100 gms. Solvent in:			
	Carbon Tetrachloride	Acetone	Methanol	Acetonitrile
-40	-	-	16.0	-
-30	-	-	31.0	-
-20	-	-	35.2	-
-10	-	-	83.1	-
0	-	-	113.8	4.8
+10	-	-	145.8	10.9
20	-	-	180.0	18.2
30	1.21	2.88	226.6	32.8
40	34.2	9.76	-	81.2
45	102.	41.75(50°)	-	-
50	gel	91.9 (55°)	-	-
		110.6 (56.5°)		

PYRENE $C_{16}H_{10}$

The solubility of Pyrene in Water, determined fluorimetrically, is 0.000001 mol. per liter at 20°. Results are also given for the influence of Caffeine, Tetramethyl Uric Acid, and Theophylline on the solubility of Pyrene in Water.

The solubility of 3, 4-Benzpyrene in Water is 0.000000024 mol. per liter at 20°. (Weil-Malherb, 1946).

BENZOYL HYDROTROPIC ACID $C_{16}H_{14}O_3$

Freezing-point data for mixtures of the dextro and levo forms of Benzoyl Hydrotropic Acid are given by Bickel and Peaslee, Jr., 1948.

2, 3-DIPHENYL BUTANE $CH_3(CH_2)_2CH(C_6H_5)_2$

Freezing-point data for mixtures of the dextro and levo forms of 2, 3-Diphenyl Butane are given by Richmond, Underhill, Brook, and Wright, 1947).

DIISOPROPYL NAPHTHALENE $C_{10}H_6[(CH_3)_2CH]_2$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIISOPROPYL NAPHTHALENE AND SEVERAL SOLVENTS
(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Triethanol Amine	265	p Amino Ethyl Acetanilide	60
Diethanol Amine	258	Methyl Sulfate	19
Hydroquinone	233	Phenyl Ethanol Amine	21
Adipic Acid	253	Nitro Methane	35
Diethylene Glycol	214	Methanol	58
p Phenylene Diamine	181	Furfuryl Alcohol	18
Triethylene Glycol	177	Chloro Acetic Acid	< 38
Benzidine	144	Phenyl Hydrazine	7
p Nitro Aniline	< 132	Acetonitrile	12
p Amino Acetophenone	98	Ethylene Chlorohydrin	-28
Ethylene Diformate	118	Acetic Anhydride	-13
Salicyl Alcohol	96	Ethylene Diacetate	-26
Maleic Anhydride	91	Sulfur Dioxide	< -78
Aceto Acetanilide	68		

PENTA ACETYL GLUCOSE $C_{16}H_{22}O_{11}$

The distribution coefficient of Penta Acetyl Glucose between Ethyl Ether and Water, for a concentration of 55.2 millimols per liter of the ether layer divided by 3.36 millimols per liter of the water layer is 16 at 20°. (Collander, 1949).

CAPRANILIDE $CH_3(CH_2)_8CONH(C_6H_5)$

SOLUBILITY OF CAPRANILIDE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_8CONH(C_6H_5)$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	10.1(13.7)	3.3(3.6)	34.2	17.1	39.1	25.5
30	67.0(110.)	29.9(78.)	52.0(110)	53.0(72.)	93.0	81.0
50	283.	273.	275.	248.	490.	280.
60	720.	680.	880.	750.	870.(56.5°)	800.
70	∞	∞	∞	∞		∞

Gms. $CH_3(CH_2)_8CONH(C_6H_5)$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	18.3	18.3	33.6	19.0	25.3	14.0	9.3
30	42.6(62.0)	70.1	81.0	46.4(67)	55.0(100)	21.8	18.0
50	198.	400.	365.0	220.	221.	133.0	297.0
60	-	1050	1125.0	665.0	-	-	825.0
70	∞	2250(64.7°)	∞	∞	∞	∞	∞

The results in parentheses at 10° and 30° are for an unstable modification of the compound which has a greater solubility than the stable form.

DIAMYL BENZENE $C_6H_4[CH_3(CH_2)_4]_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIAMYL BENZENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Hydroquinone	> 256	m Nitro Acetophenone	93
Diethylene Glycol	262	Benzyl p Hydroxy Benzoate	99
Triethylene Glycol	234	Methanol	76
o Nitro Benzoic Acid	250	Furfuryl Alcohol	82
p Amino Acetophenone	196	Chloro Acetic Acid	56
Ethylene Diformate	172	Phenyl Hydrazine	81
Maleic Anhydride	191	Acetonitrile	67
p Amino Benzophenone	177	Ethylene Chloro Hydrin	70
Aceto Acetanilide	162	Furfural	47
2, 4-Dinitro Phenol	151	Phenyl Phthalate	49
p Amino Ethyl Acetanilide	154	Acetic Anhydride	44
Catechol	144	Ethylene Diacetate	31
Antipyrine	128	Ethyl Phenyl Ethanol Amine	< 27
Methyl Sulfate	114	Tetrahydro Furfuryl Alcohol	12
Phenyl Ethanol Amine	113	Aniline	12
m Dinitro Benzene	119	Acetonyl Acetone	21
2, 4 Dinitro Chloro Benzene	101	Triphenyl Phosphite	< 31
Nitro Methane	85	Sulfur Dioxide	-8

PANTOCAIN $C_{16}H_{26}O_2N_2$

The distribution coefficient of Pantocain between Ethyl Ether and Water, $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ is 1106 at about 20°. (Collander, 1949, quoted from Eisenbrandt and Picher, 1938).

PALMITONITRILE $CH_3(CH_2)_{14}CN$

THE SOLUBILITY OF PALMITONITRILE IN SEVERAL SOLVENTS

(Hoerr, Binkerd, Pool, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{14}CN$ per 100 gms. Solvent in:					
	Benzene	Cyclo-hexane	Tetrachloro Methane	Trichloro Methane	Ethyl Ether	Glacial Acetic Acid
-40	-	-	-	6.3	0.4	-
-20	-	-	1.5	17.7	3.6	-
0	-	-	15.7	52.0	21.0	-
+10	101	43.2	41.	95.	52.	-
20	250	198.	120.	213.	139.	48.0
30	2750	2700.	1725.	2300.	1700.	1075.

t°	Gms. $CH_3(CH_2)_{14}CN$ per 100 gms. Solvent in: Ethyl Acetate	Butyl Acetate	Acetone	n Butanone	Methanol
-40	0.5	1.1	0.3	1.2	0.1
-20	2.0	3.0	1.0	3.1	0.2
0	10.7	12.6	9.5	16.4	0.8
+10	38.7	34.2	47.8	60.	2.6
20	163.0	125.	187.	205.	16.8
30	2400.0	1850.	2450.	2750.	770.0

t°	Gms. $CH_3(CH_2)_{14}CN$ per 100 gms. Solvent in: 95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Acetonitrile
-40	0.6	0.6	0.7	0.1	-
-20	0.7	1.0	1.2	1.0	0.1
0	1.7	2.2	3.6	6.6	1.3
+10	5.0	7.2	12.0	20.2	4.6
20	33.0	40.8	58.	127.	94.
30	1000.0	1000.0	1175.	2850.	4250.

THE EUTECTIC TEMPERATURES AND COMPOSITIONS OF MIXTURES OF PALMITONITRILE AND OTHER COMPOUNDS

(Hoerr, Binkherd, Pool, and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{14}CN$
Palmitonitrile + Benzene	-2.6	28.4
Palmitonitrile + Cyclohexane	2.0	5.6
Palmitonitrile + Trichloro Methane	-23.0	0.7
Palmitonitrile + Glacial Acetic Acid	15.2	18.4

The freezing-points of mixtures of Palmitonitrile and Stereonitrile are given by Hoffman, Hoerr, and Ralston, 1945.

PALMITIC ACID $CH_3(CH_2)_{14}COOH$

SOLUBILITY OF PALMITIC ACID IN WATER AND IN ALCOHOL

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{14}COOH$ per 100 gms. Solvent in: Water	91.1 Wt. % Ethanol	95 Wt. % Ethanol	99.4 Wt. % Ethanol
0	0.00046	0.76	0.85	1.89
10	-	1.94	2.10	3.20
20	0.00072	4.60	4.93	7.21
30	0.00083	15.3	16.7	23.9
40	0.0010(45.°)	-	73.4	94.2
50	-	-	286.0	320.
60	0.0012	-	2280.	2600.

SOLUBILITY OF PALMITIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{14}COOH$ per 100 gms. Solvent in:			
	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	0.60	0.90	-	-
10	1.94	3.09	1.04	-
20	5.38	8.57	7.30	2.14
30	15.6	20.6	34.8	8.11
40	58.0	66.1	105.	51.7
50	880.(56.5°)	228.	306.	313.
60	-	2390.	2170.	2280.

SOLUBILITY OF PALMITIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{14}COOH$ per 100 gms. Solvent in:				
	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	0.6	2.9	0.8	1.5
10	0.9	1.8	6.0	2.2	3.8
20	6.5	5.8	15.1	6.1	8.9
30	27.4	21.5	36.4	17.6	23.4
40	92.0	72.	91.0	53.	69.
50	285.	212.	250.	203.	226.
60	2530.	1590.	1820.	2340.	2330.

t°	Gms. $CH_3(CH_2)_{14}COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	0.8	2.4	1.9	-	< 0.1
10	1.3	4.6	4.2	-	0.2
20	3.7	10.9	10.5	< 0.1	0.4
30	13.4	32.3	30.0	0.7	1.0
40	77.	94.	84.	2.6	2.8
50	420.	270.	243.	10.	9.9
60	4650.	2460.	1960.	1650.	1200.

THE EUTECTICS OF MIXTURES OF PALMITIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{14}COOH$
Palmitic Acid + Cyclohexane	6.4	0.4
Palmitic Acid + Benzene	5.4	0.19
Palmitic Acid + Glacial Acetic Acid	16.17	1.23

SOLUBILITY OF PALMITIC ACID IN SEVERAL SOLVENTS

(Hoerr, Sedgwick, and Ralston, 1946)

t°	Gms. $CH_3(CH_2)_{14}COOH$ per 100 gms. Solvent in: Toluene	o Xylene	Chloro Benzene	Nitro Benzene
0	0.2	< 0.1	< 0.1	-
10	2.2	1.9	1.6	-
20	8.7	7.9	7.8	0.1
30	30.0	25.2	25.8	1.2
40	80.6	77.0	76.4	6.4
50	244.	235.0	230.0	55.5
				1215.0(60°)

t°	Gms. $CH_3(CH_2)_{14}COOH$ per 100 gms. Solvent in: 1, 4 Dioxane	Furfural	1, 2 Dichloro Ethane	Nitro Methane
0	-	- (1.1)	-	-
10	-	-	-	-
20	10.9	- (1.6, 25°)	0.6	0.5
30	32.8	-	6.0	0.9
40	91.0	1.6(10.2)	39.7	1.4
50	248.	15.9	187.0	2.2
60	1730.	1800.0	1650.0	4.1

The results in parentheses, for the solubility in Furfural, in terms of Wt.% of Technical Palmitic Acid, are given by Trimble, 1941.

THE SOLUBILITY OF MIXTURES OF PALMITIC AND STEARIC ACIDS IN BENZENE

(Ralston and Hoerr, 1946)

t°	Gms. per 100 gms. Mixture: Stearic Acid	Palmitic Acid	Benzene
10	0.24	0.00	99.76
	0.58	0.07	99.35
	0.66	0.16	99.18
	1.20	0.80	98.00
	1.22	1.22	97.56
	1.35	2.02	96.63
	1.72	4.00	94.28
	0.89	3.55	95.56
	0.29	2.61	97.10
	0.00	1.04	98.98
20	2.40	0.00	97.60
	3.60	0.40	96.00
	4.64	1.16	94.20
	5.94	3.96	90.10
	6.75	6.75	86.50
	6.44	9.66	83.90
	6.70	15.65	77.65
	3.83	15.32	80.85
	1.25	11.25	87.50
	0.00	6.80	93.20
30	11.0	0.0	89.0
	15.0	1.7	83.3
	19.0	4.8	76.2
	20.8	13.9	65.3
	19.7	19.7	60.6
	13.9	32.9	53.7
	3.5	31.6	64.9
	0.0	25.8	74.2

t°	Gms. per 100 gms. Mixture: Stearic Acid	Palmitic Acid	Benzene
40	33.8	0.0	66.2
	37.1	4.1	58.8
	39.8	10.0	50.2
	37.3	24.8	37.9
	32.4	32.4	35.2
	26.6	40.0	33.4
	21.1	49.2	29.7
	13.5	54.0	32.5
	6.0	54.3	39.7
	0.0	51.2	47.8
50	59.2	0.0	40.8
	59.6	6.6	33.8
	60.2	15.1	24.7
	52.6	35.0	12.4
	44.5	44.5	11.0
	36.0	54.0	10.0
	27.7	64.7	7.6
	18.0	72.0	10.0
	8.4	75.6	16.0
	0.0	75.3	24.7
60	82.4	0.0	17.6
	79.5	8.8	11.7
	76.3	19.1	4.6
	72.4	27.6	0.0
	6.3	93.7	0.0
	0.0	95.5	4.5
70	∞	∞	∞

SOLUBILITY OF MIXTURES OF PALMITIC AND STEARIC ACIDS IN ACETONE

(Ralston and Hoerr, 1945)

t°	Gms. per 100 gms. Mixture			t°	Gms. per 100 gms. Mixture		
	Stearic Acid	Palmitic Acid	Acetone		Stearic Acid	Palmitic Acid	Acetone
10	0.80	0.00	99.20	30	9.2	13.7	77.1
	0.90	0.10	99.00		7.9	18.5	73.6
	1.04	0.26	98.70		4.8	19.4	75.8
	1.24	0.82	97.94		0.0	13.5	86.5
	1.19	1.19	97.62	40	14.5	0.0	85.5
	1.00	1.50	97.50		16.2	1.8	82.0
	0.84	2.06	97.10		27.2	6.8	66.0
	0.53	2.12	97.35		27.8	18.5	53.7
	0.00	1.91	98.09		26.1	26.1	47.8
20	1.52	0.00	98.48		21.9	33.0	45.1
	1.86	0.21	97.93		17.8	41.5	40.7
	2.90	0.73	96.37		11.2	44.8	44.0
	3.33	2.22	94.45		0.0	36.7	63.7
	3.25	3.25	93.50	50	43.6	0.0	56.4
	3.02	4.53	92.45		49.4	5.5	45.1
	2.96	5.74	91.30		55.4	13.9	30.7
	1.64	6.56	91.80		50.3	33.5	16.2
	0.00	5.11	94.89		42.7	42.7	14.6
30	4.7	0.0	95.3		34.6	51.9	13.5
	5.0	0.6	94.4		27.4	63.8	8.8
	8.4	2.1	89.5		17.6	70.2	12.2
	9.1	6.0	84.9		0.0	69.7	30.3
	9.6	9.6	80.8				

The published paper gives the results only in the form of a diagram. The above numerical values were kindly supplied by the authors.

Results in close agreement with the above were obtained for the solubility of mixtures of Palmitic and Stearic Acids in Chloroform and in Ethyl Acetate.

The solubility of mixtures of Palmitic Acid and Heptadecane in 2- Butanone, as well as the freezing-points of mixtures of Palmitic Acid and Heptadecane, are given in the form of diagrams by Ralston and Hoerr, 1945.

Freezing-point data are given by Weitkamp, 1945, for mixtures of Palmitic and Isopalmitic Acids, and also for binary mixtures of the following fatty acids and their Amides: Heptadecanoic (Margaric), Hexadecanoic (Palmitic), Octadecanoic (Stearic), Nonadecanoic, Methyl Nonadecanoic (Isoarachidic), Methyl Heptyl Decanoic (Isostearic), Methyl Eicosanoic (Arachidic) and Octadecanoic.

PALMITO 4-ANISIDINE 2-SODIUM SULFONATE
PALMITO 4 PHENETIDINE 2- SODIUM SULFONATE

Results for the solubility of these compounds in water are given in the form of diagrams showing that above a certain temperature the increase in solubility is extremely rapid with small increments of temperature. See Note under Cetyl Pyridinium Bromide. (Adam and Parkhurst, 1946).

CETYL PYRIDINIUM BROMIDE, CHLORIDE and IODIDE

SOLUBILITY OF CETYL SALTS, EACH SEPARATELY, IN WATER

(Adam and Parkhurst, 1946)

Note. In the case of these salts the solubility below a given temperature is small, but above this temperature it increases extremely rapidly with small increments of temperature. The results are given only in the form of a diagram from which the following approximate numerical values were estimated. The determinations were made by sealing weighed amounts of the salt and water in pyrex tubes and observing the temperature at which a clear solution was obtained on slow warming.

Cetyl Pyridinium Bromide		Cetyl Pyridinium Chloride		Cetyl Pyridinium Iodide	
t°	Gms. $CH_3(CH_2)_{15}\cdot NC_5H_4Br$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_{15}\cdot NC_5H_4Cl$ per 100 gms. H_2O	t°	Gms. $CH_3(CH_2)_{15}\cdot NC_5H_4I$ per 100 gms. H_2O
25	> 0.1	12	> 0.1	43	> 0.1
27.5	0.5	15	0.3	45	0.6
30	2.0	17	1.0	46	1.0
32	5.0	20	6.0	47	6.0
32.5	10.0	22	10.0	48	10.0

Similar results are also given for Cetyl Trimethyl Ammonium Bromide and Iodide and for Cetyl Sodium Sulfate.

PALMITAMIDE $CH_3(CH_2)_{14}CONH_2$

SOLUBILITY OF PALMITAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

t°	Gms. $CH_3(CH_2)_{14}CONH_2$ per 100 gms. Solvent in:					
	Benzene	Cyclo-hexane	Tetrachloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	0.3	-	-	0.2	0.3	0.4
30	0.4	0.3	0.1	0.6	0.8	1.0
50	2.0	0.4	0.3	2.9	3.9	4.8
60	7.6	0.8	3.5	8.5	6.9(56.5°)	12.7
70	41.2	8.8	19.8	27.7	-	39.1
80	145.0	122.(81.4°)	46.5(76°)	65.0(77.2°)	-	118.0

t°	Gms. $CH_3(CH_2)_{14}CONH_2$ per 100 gms. Solvent in:						
	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	0.2	0.7	0.4	0.4	0.3	0.2	0.2
30	0.8	1.2	1.5	1.8	1.9	0.3	0.3
50	4.6	10.0	10.6	12.4	11.2	0.9	0.7
60	-	32.0	29.4	29.9	-	-	1.6
70	25.0	51.0(64.7°)	89.0	79.0	67.	7.5	5.9
80	-	-	216.(78.5°)	229.(82.3°)	-	-	34.8(82.0°)
90	205.	-	-	-	353.	208.	-
100	670.	-	-	-	1050.	1075.	-

HEXADECANE $CH_3(CH_2)_{14}CH_3$

The critical solution temperature of mixtures of Hexadecane and Aniline is 95°. The Aniline point is at 88°. (Ludeman, 1944, quoted from Shepard, Henne, and Midgley, 1931, and Garner, 1928).

THE SOLUBILITY OF HEXADECANE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Crews, 1944)

t°	Gms. $CH_3(CH_2)_{14}CH_3$ per 100 gms. Solvent in: Benzene	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether
-30	-	-	-	0.4	1.4
-20	-	-	5.5	2.2	5.4
-10	-	-	15.1	8.1	16.3
0	-	-	56.0	32.4	64.0
+10	360.	430.	245.	214.	302.
15	1440.	1440	790.	1020.	1200.

t°	Gms. $CH_3(CH_2)_{14}CH_3$ per 100 gms. Solvent in: Ethyl Acetate	Butyl Acetate	Acetone	2 Butanone	Iso-propanol	n Butanol
-20	-	0.2	-	-	< 0.1	0.3
-10	0.1	1.6	< 0.1	0.3	0.4	1.2
0	3.0	9.9	1.2	2.6	1.7	4.1
+10	50.	138.	5.3	17.6	7.5	16.7
15	840.	1000.	13.0	830.0	21.2	50.

THE EUTECTICS OF MIXTURES OF HEXADECANE AND OTHER COMPOUNDS
(Ralston, Hoerr, and Crews, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{14}CH_3$
Hexadecane + Benzene	-1.3	32.4
Hexadecane + Cyclohexane	-12.5	17.6
Hexadecane + Tetra Chloro Methane	-26.2	3.5

HEXADECANOL $CH_3(CH_2)_{14}CH_2OH$

SOLUBILITY OF HEXADECANOL IN SEVERAL SOLVENTS
(Hoerr, Harwood, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{14}CH_2OH$ per 100 gms. Solvent in: Benzene	Cyclohexane	Nitro Ethane	Acetonitrile
10	2.8	2.2	-	-
20	13.5	11.0	< 0.1	0.1
30	73.0	66.0	1.6	1.1
40	302.	285.	13.4	5.6
50	∞	∞	∞	20.9

Gms. $CH_3(CH_2)_{14}CH_2OH$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone
-20	-	-	0.3	-	-
0	0.4	1.6	2.1	0.1	1.6
+10	1.5	-	5.3	1.3	4.9
20	8.6	24.0	13.8	6.7	14.2
30	47.7	76.0	46.0	30.9	50.0
40	185.0	262.0	225.0	290.0	290.0

Gms. $CH_3(CH_2)_{14}CH_2OH$ per 100 gms. Solvent in:

t°	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-20	-	0.1	-	-	< 0.1	0.5
0	1.6	3.0	0.3	1.8	3.1	4.0
+20	24.0	26.1	10.0	15.9	23.7	24.8
30	76.0	76.0	105.	89.0	95.0	78.0
40	262.0	123. (34.5°)	500.	430.0	410.0	275.0

The Eutectic of mixtures of:

Hexadecanol + Benzene is at about 5.5° and 1.7 Wt. % $CH_3(CH_2)_{14}CH_2OH$
Hexadecanol + Cyclohexane is at 6.5° and 1.4 Wt. % $CH_3(CH_2)_{14}CH_2OH$

HEXADECYLAMINE $CH_3(CH_2)_{14}CH_2NH_2$

SOLUBILITY OF HEXADECYLAMINE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Pool, 1944)

Gms. $CH_3(CH_2)_{14}CH_2NH_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
-20	-	-	0.3	-0.2	-	-	-
0	-	-	3.2	3.5	-	-	-
+10	10.0	7.4	-	-	-	-	-
20	30.7	26.6	19.7	29.9	< 0.1	8.3	0.2
30	98.	86.	63.	64.	4.7	48.	1.3
40	388.	360.	295.	295.	445.	580.	14.8
50	∞	∞	∞	∞	∞	∞	∞

Gms. $CH_3(CH_2)_{14}CH_2NH_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-40	-	2.4	-	-	-	-	-
-20	0.5	6.6	-	0.2	-	0.4	< 0.1
0	3.2	17.0	0.2	6.1	3.0	7.3	3.9
+20	21.2	56.	18.5	116.	83.0	68.0	55.0
30	73.	117.	72.	256.	239.0	169.	148.0
40	335.	378.	135. (34.5°)	785.	770.0	580.	515.
50	∞	∞	-	∞	∞	∞	∞

THE EUTECTICS OF MIXTURES OF HEXADECYLAMINE AND OTHER COMPOUNDS
(Ralston, Hoerr, and Pool, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{14}CH_2NH_2$
Hexadecylamine + Benzene	4.6	6.1
Hexadecylamine + Cyclohexane	4.0	2.7
Hexadecylamine + Tetra Chloro Methane	-23.0	0.4

HEXADECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{14}CH_2NH_2 \cdot HCl$

Results for the solubility of Hexadecylamine Hydrochloride in 95 Wt. % Ethanol, at temperatures between 10° and 75° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

HEXADECYLAMINE ACETATE $CH_3(CH_2)_{14}CH_2NH_2{\cdot}CH_3COOH$

Results for the solubility of Hexadecylamine Acetate in 95 Wt. % Ethanol and in Benzene, at temperatures between 20° and 65° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

DIOCTYL AMINE α and β forms, $NH[CH_2(CH_3)_7]_2$

SOLUBILITY OF THE α AND β FORMS OF DIOCTYL AMINE, EACH SEPARATELY, IN SEVERAL SOLVENTS
(Hoerr, Harwood, and Ralston, 1944)

Gms. α and β $NH[CH_2(CH_3)_7]_2$ per 100 gms. Solvent in:

t°	Benzene		Cyclohexane		Ethyl Acetate		Butyl Acetate	
	α Form	β Form	α Form	β Form	α Form	β Form	α Form	β Form
0	-	-	-	-	18.3	8.1	38.0	15.4
10	780	100	740	122	∞	268.0	∞	276.0
20	∞	710	∞	650	-	∞	-	∞

Gms. α and β $NH[CH_2(CH_3)_7]_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane		Trichloro Methane		Ethyl Ether	
	α Form	β Form	α Form	β Form	α Form	β Form
-10	13.2	8.6	36.0	26.0	17.0	9.6
0	-	-	-	-	58.0	30.9
+10	330.0	94.0	390.0	139.0	255.0	89.0
20	∞	355.0	∞	435.0	∞	308.0

SOLUBILITY OF THE β FORM OF DIOCTYL AMINE IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

t°	Gms. β $NH[CH_2(CH_3)_7]_2$ per 100 gms. Solvent in:						
	Acetone	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Aceto-nitrile
-10	-	-	58.	4.6	26.8	45.9	-
0	1.9	4.9	-	-	-	-	-
+10	-	-	66.5	63.0	233.0	282.0	-
20	625.0	650.	-	-	-	-	3.4
30	∞	∞	∞	∞	∞	∞	5.4
40	-	-	-	-	-	-	7.0
50	-	-	-	-	-	-	9.1
60	-	-	-	-	-	-	11.5
70	-	-	-	-	-	-	14.9

THE EUTECTICS OF MIXTURES OF α AND β FORM OF DIOCTYL AMINE AND OTHER COMPOUNDS

(Hoerr, Harwood, and Ralston, 1944)

Mixture	t°	Wt. % $NH[CH_2(CH_3)_7]_2$
α Dioctyl Amine (m.pt. 14.6°) + Benzene	1.5	41.6
β Dioctyl Amine (m.pt. 26.7°) + Benzene	0.4	37.6
α Dioctyl Amine + Cyclohexane	-7.6	17.5
β Dioctyl Amine + Cyclohexane	-2.8	12.7
α Dioctyl Amine + Tetra Chloro Methane	-2.39	1.6
β Dioctyl Amine + Tetra Chloro Methane	-23.4	0.7

4, 5-DIPHENYL PIPERIDONE-2 α and β forms $C_{17}H_{17}NO$

The freezing-points (m.pts.) of mixtures of the α and β forms of 4, 5-Diphenyl Piperidone are given by Koelsch, 1943.

MORPHINE $C_{17}H_{19}NO_3 \cdot H_2O$

SOLUBILITY OF MORPHINE IN WATER

(Selles, 1941)

t°	Gms. $C_{17}H_{19}NO_3$ per 1000 cc H_2O	t°	Gms. $C_{17}H_{19}NO_3$ per 1000 cc H_2O
13	0.26	60	0.64
20	0.31	70	0.82
30	0.35	80	1.10
40	0.40	90	1.47
50	0.50		

The distribution coefficient of Morphine between Ethyl Ether and Water $(\frac{\text{conc. Ether}}{\text{conc. } H_2O})$ for a concentration of about 1 millimol per liter in the water layer is 0.21 at 18°. (Collander, 1949).

Correction to Vol. 2, 3rd. Ed. Solubilities, p. 775, first and second tables, change, in four places, the formulae of **DIETHYL DIPHENYL UREA**, from $N(C_2H_5)_2N(C_6H_5)_2CO$ to $(C_2H_5NC_6H_5)_2CO$; also, in first line of figures in first table, fifth column, change (0.3 at 85°) to (0.03 at 85°).

COCAINE (I) $C_{17}H_{21}O_4N$

The distribution coefficient of Cocaine between Ethyl Ether and Water, for a concentration of 125 millimols per liter in the ether layer divided by 0.95 millimols per liter in the water layer is 138 at 18°. (Collander, 1949).

ATROPINE $C_{17}H_{23}O_3N$

The distribution coefficient of Atropine between Ethyl Ether and Water for a concentration of 21.9 millimols per liter in the ether layer divided by 5.22 millimols per liter in the water layer is 4.1 at 19°. (Collander, 1949).

HEPTADECYLIC ACID (Margaric Acid) $CH_3(CH_2)_{15}COOH$

SOLUBILITY OF HEPTADECYLIC ACID IN SEVERAL SOLVENTS
(Ralston and Hoerr, 1942)

Gms. $CH_3(CH_2)_{15}COOH$ per 100 gms. Solvent in:

t°	Water	95 Wt. % Ethanol	99.4 Wt. % Ethanol	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	0.00028	1.03	2.04	0.40	0.71	-	-
10	-	1.68	2.98	1.50	2.88	1.52	-
20	0.00042	4.17	6.62	4.28	7.41	9.23	1.27
30	0.00055	15.30	22.2	14.6	20.3	42.1	6.52
40	0.00069 (45°)	84.2	110.	67.5	77.7	121.0	61.0
50	-	344.0	388.	1330.0 (56.5°)	288.0	369.	384.
60	0.00081	6560.0	8230.	-	6560.	5450.	6560.

SOLUBILITY OF HEPTADECYLIC ACID IN SEVERAL SOLVENTS
(Hoerr and Ralston, 1944)

Gms. $CH_3(CH_2)_{15}COOH$ per 100 gms. Solvent in:

t°	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	0.7	3.6	0.4	1.2
10	1.5	2.0	7.5	1.6	3.5
20	8.4	6.8	17.8	5.3	8.7
30	34.0	25.1	42.6	16.8	24.0
40	108.	83.	106.	59.	75.
50	365.	250.	297.	242.	269.
60	7600.	4650.	5000.	6000.	6350.

t°	Gms. $CH_3(CH_2)_{15}COOH$ per 100 gms. Solvent in: Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	0.1	1.2	1.6	-	-
10	0.7	3.0	3.6	-	< 0.1
20	2.5	10.8	9.5	-	0.2
30	9.9	37.9	27.4	0.2	0.6
40	62.	108.	85.	1.9	1.9
50	500.	345.	274.	9.6	8.3
60	12,000.	6550.	4900.	4250.	3600.

EUTECTICS OF MIXTURES OF HEPTADECYLIC ACID AND OTHER COMPOUNDS

(Ralston and Hoerr, 1942; Hoerr and Ralston, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{15}COOH$
Heptadecylic Acid + Cyclohexane	6.3	0.7
Heptadecylic Acid + Benzene	5.35	0.42
Heptadecylic Acid + Glacial Acetic Acid	16.34	0.58

HEPTADECANE $CH_3(CH_2)_{15}CH_3$

SOLUBILITY OF HEPTADECANE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Crews, 1944)

t°	Gms. $CH_3(CH_2)_{15}CH_3$ per 100 gms. Solvent in: Benzene	Cyclo-hexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Ethyl Acetate
-30	-	-	-	0.9	1.0	-
-20	-	-	4.7	3.1	4.6	0.1
-10	-	-	12.5	10.2	13.2	0.9
0	-	-	47.	42.2	49.5	4.1
+10	260.	274.	174.	174.	196.	21.2
15	640.	640.	380.	420.	480.	420.0

t°	Gms. $CH_3(CH_2)_{15}CH_3$ per 100 gms. Solvent in: Butyl Acetate	Acetone	2-Butanone	Isopropanol	n Butanol
-30	0.5	-	-	-	-
-20	1.3	-	0.3	-	-
-10	3.2	-	0.8	< 0.1	0.4
0	9.5	0.3	3.8	0.8	2.7
+10	97.0	3.2	16.7	5.0	13.0
15	530.	8.5	220.	11.7	35.6

EUTECTICS OF MIXTURES OF HEPTADECANE AND OTHER COMPOUNDS

(Ralston, Hoerr, and Crews, 1944)

Mixture	t°	Wt. % $CH_3(CH_2)_{15}CH_3$
Heptadecane + Benzene	-1.9	37.2
Heptadecane + Cyclohexane	-10.8	17.5
Heptadecane + Tetra Chloro Methane	-25.6	3.3

HEPTADECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{15}CH_2NH_2 \cdot HCl$

Results for the solubility of Heptadecylamine Hydrochloride in 95 Wt. % Ethanol at temperatures between 20° and 75°, are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

HEPTADECYLAMINE ACETATE $CH_3(CH_2)_{15}CH_2NH_2 \cdot CH_3COOH$

Results for the solubility of Heptadecylamine Acetate in 95 Wt. % Ethanol and in Benzene, at temperatures between 20° and 65° are given in the form of diagrams by Harwood, Ralston, and Selby, 1941.

CHRYSENE $C_{18}H_{12}$

The solubility of Chrysene in water, determined fluorimetrically, is 0.0000034 mols. per liter at 20°. Results are also given for the influence of Caffeine, Tetra Methyl Uric Acid and Theophylline upon the solubility of Chrysene in Water. (Weil-Malherbe, 1946).

TRIPHENYLENE $C_{18}H_{12}$

Freezing-point data are given Sturrock and Lowe, 1939 for :

Triphenylene + Benzanthracene
Chrysene + Benzanthracene

NITRO CELLULOSE $C_{18}H_{21}O_6(OH)_2(ONO_2)_7$

Results for the solubility of Nitro Cellulose in Alcohol - Ether - Acetone mixtures, in the form of tables and diagrams, show that with increasing Nitrogen content of the Nitro Cellulose, complete solubility may be reached in solvent mixtures containing a high percentage of Acetone. Ether reduces the solvent action of the mixtures. (Eymont and Syrkin, 1935).

CODEINE $C_{18}H_{21}NO_3 \cdot H_2O$

The distribution coefficient of Codeine between Ethyl Ether and Water, for a concentration of 10.2 millimols per liter in the ether layer, divided by 12.7 millimols per liter in the water layer is 0.8 at about 20°. (Collander, 1949).

DI tert. BUTYL NAPHTHALENE $C_{10}H_6[(CH_3)_3C]_2$

CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DI tert. BUTYL NAPHTHALENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Hydroquinone	257	o Nitro Benzoic Acid	135
Diethylene Glycol	231	Ethylene Diformate	150
Triethylene Glycol	190	Catechol	100

LAURANILIDE $CH_3(CH_2)_{10}CONH(C_6H_5)$

SOLUBILITY OF LAURANILIDE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_{10}CONH(C_6H_5)$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	1.5	0.6	8.5	6.8	6.3	10.7
30	14.7(56.0)	0.9(2.8)	14.0(43.0)	17.2(23.0)	12.5	34.8
50	155.	105.	134.0	107.	210.0	152.
60	340.	265.	375.0	286.	352.(56.5°)	358.
70	1000	785	1375.	1250.	-	1350
80	∞	∞	∞	∞	-	∞

Gms. $CH_3(CH_2)_{10}CONH(C_6H_5)$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	10.5	2.9	10.7	6.7	13.2	6.0	0.8
30	21.1(25.0)	11.1	22.3	16.6(25.0)	26.1(37.0)	8.5	3.0
50	86.	187.0	128.	102.	108.	22.3	24.1
60	-	430.	365.	254.	-	-	308.
70	730	645.(64.7°)	450.	930	890.	720.	1100
80	-	-	∞	-	-	-	-
90	∞	-	-	∞	∞	∞	∞

The results in parentheses at 30° are for an unstable modification which has a greater solubility than the stable form.

HEXA ETHYL BENZENE See page 820.

OLEIC ACID $C_8H_{17}CH:CH(CH_2)_7COOH$

RECIPROCAL SOLUBILITY OF OLEIC ACID, CARBON DISULFIDE AND METHYL ALCOHOL
(Martinez-Moreno and Crespi-Gonzalez, 1948)

Limiting Solubility Concentrations:

At 0°

Gms. per 100 gms. Mixture

Oleic Acid	CS_2	CH_3OH
4.3	92.8	2.9
5.8	88.1	6.1
7.3	80.1	12.6
7.8	72.7	19.5
7.7	65.1	27.2
6.4	57.5	36.1
4.6	49.1	46.3
0.9	40.2	58.9

At 25°

Gms. per 100 gms. Mixture

Oleic Acid	CS_2	CH_3OH
0.0	50.1	49.9
0.4	51.3	48.3
2.6	59.8	37.6
3.7	67.9	28.4
3.8	75.9	20.3
3.4	83.5	13.1
2.9	90.8	6.3
0.4	96.4	3.2
0.0	97.9	2.1

Tie Lines at 25°

CS_2 Rich Layer			CH_3OH Rich Layer		
Gms. per 100 gms. Mixture			Gms. per 100 gms. Mixture		
Oleic Acid	CS_2	CH_3OH	Oleic Acid	CS_2	CH_3OH
0.9	95.8	3.3	1.5	54.5	44.0
1.4	94.8	3.8	2.1	57.9	40.0
2.5	92.0	5.5	2.9	62.1	35.0

Similar results for Olive Oil + CS_2 + CH_3OH at 25° and for the quaternary system Oleic Acid + Olive Oil + CS_2 + CH_3OH at 25° are also given.

Results for Oleic Acid + Olive Oil + CH_3OH are given by Ruis and Martinez-Moreno, 1947.

Results for Palm Oil + Fatty Acids of Palm Oil + CH_3OH at 50° are given by Martinez-Moreno and Paniagua, 1949.

OLEO 4 - ANISIDINE, 2 - SODIUM SULFATE

Results for the solubility of this compound in Water are given in the form of a diagram showing that above a certain temperature the increase in solubility is extremely rapid with each small increment of temperature (See Note under Cetyl Pyridinium Bromide p.775) (Adam and Fankhurst, 1946).

ELAIDIC ACID $C_8H_{17}CH{:}CH(CH_2)_7COOH$

Freezing-points of mixtures of Elaidic Acid and Palmitin are given by Efremov, Vinogradova, and Tichomirova, 1937.

STEARONITRILE $CH_3(CH_2)_{16}CN$

SOLUBILITY OF STEARONITRILE IN SEVERAL SOLVENTS
(Hoerr, Binkerd, Pool, and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{16}CN$ per 100 gms. Solvent in:					
	Benzene	Cyclo-hexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Glacial Acetic Acid
-40	-	-	-	2.3	0.1	-
-20	-	-	0.2	7.8	0.9	-
0	-	-	5.2	28.2	7.5	-
+10	50.	11.2	15.1	53.0	22.2	-
20	104	55.	41.2	102.	56.0	5.4
30	264	223.	130.0	233.	155.0	47.6

t°	Gms. $CH_3(CH_2)_{16}CN$ per 100 gms. Solvent in: Ethyl Acetate	Butyl Acetate	Acetone	n Butanone	Methanol
-40	-	0.2	-	0.1	-
-20	0.1	0.4	0.1	0.4	-
0	2.3	3.2	1.0	5.1	-
+10	9.2	11.7	8.8	17.1	0.2
20	40.3	38.8	53.0	65.0	1.6
30	175.0	142.0	197.0	238.0	13.6

t°	Gms. $CH_3(CH_2)_{16}CN$ per 100 gms. Solvent in: 95 Wt. % Ethanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
-40	0.2	0.1	0.2	-	-
-20	0.3	0.2	0.5	0.1	-
0	0.5	0.8	1.4	0.8	0.1
+10	0.9	2.2	3.8	3.9	0.5
20	4.5	8.6	16.2	17.8	3.6
30	35.7	54.0	83.0	137.0	115.0

THE EUTECTICS OF MIXTURES OF STEARONITRILE AND OTHER COMPOUNDS

Mixture	t°	Wt. % $CH_3(CH_2)_{16}CN$
Stearonitrile + Benzene	+1.2	19.2
Stearonitrile + Cyclohexane	4.8	2.8
Stearonitrile + Trichloro Methane	-22.8	0.1
Stearonitrile + Glacial Acetic Acid	16.4	3.1

STEARIC ACID $CH_3(CH_2)_{16}COOH$

SOLUBILITY OF STEARIC ACID IN WATER AND IN AQUEOUS ALCOHOL

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Solvent in: Water	80.8 Wt. % Ethanol	91.0 Wt. % Ethanol	95 Wt. % Ethanol	99.4 Wt. % Ethanol
0	0.00018	0.06	0.13	0.24	0.42
10	-	0.10	0.35	0.65	1.09
20	0.00029	0.20	0.66	1.13	2.25
30	0.00034	0.81	2.30	3.42	5.42
40	0.00042(45°)	3.20	13.5	17.1	22.7
50	-	50.8	68.7	83.9	105.0
60	0.00050	238.0	-	365.0	400.0

SOLUBILITY OF STEARIC ACID IN SEVERAL SOLVENTS

(Ralston and Hoerr, 1942)

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Solvent in:			
	Acetone	2-Butanone	Benzene	Glacial Acetic Acid
0	0.21	0.25	-	-
10	0.80	1.01	0.24	-
20	1.54	2.99	2.46	0.12
30	4.93	8.34	12.4	1.68
40	17.0	24.8	51.0	7.58
50	220.(56.5°)	84.7	145.	74.8
60	-	344.0	468.	485.0

SOLUBILITY OF STEARIC ACID IN SEVERAL SOLVENTS

(Hoerr and Ralston, 1944)

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Solvent in;				
	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Acetate	Butyl Acetate
0	-	-	0.4	-	0.1
10	0.2	0.2	2.0	-	0.2
20	2.4	2.4	6.0	0.5	1.6
30	10.5	10.7	17.5	5.2	8.1
40	43.8	36.4	48.7	21.6	28.7
50	133.	108.	124.	78.	97.
60	450.	325.	365.	348.	350.

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Solvent in:				
	Methanol	Isopropanol	n Butanol	Nitro Ethane	Acetonitrile
0	-	0.1	-	-	-
10	-	0.4	0.2	-	-
20	0.1	2.0	1.6	-	< 0.1
30	1.8	10.0	9.0	-	0.3
40	11.7	38.1	36.2	0.3	0.8
50	78.0	118.	111.	2.7	2.0
60	520.0	422.	370.	14.0	10.3

SOLUBILITY OF STEARIC ACID IN SEVERAL SOLVENTS

(Hoerr, Sedgwick, and Ralston, 1946)

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Solvent in:			
	Toluene	o Xylene	Chloro Benzene	Nitro Benzene
10	< 0.1	< 0.1	< 0.1	-
20	2.0	1.7	2.2	-
30	10.6	9.1	10.8	< 0.1
40	36.6	34.6	38.3	1.4
50	103.0	102.0	102.0	9.8
				112.0(60°)

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Solvent in:			
	1, 4 Dioxane	Furfural	1, 4 Dichloro Ethane	Nitro Methane
20	4.3	-	-	0.4
30	15.3	-	1.0	0.7
40	48.8	-	10.0	1.0
50	132.	2.6	70.0	1.3
60	415.	28.5	280.	1.9
				3.6(60°)
				5.5(70°)

SOLUBILITY OF STEARIC ACID IN FURFURAL

(Trimble, 1941)

t°	Gms. $CH_3(CH_2)_{16}COOH$ per 100 gms. Sat. Sol.
0	0.3
25	2.1
40	13.1

EUTECTICS OF MIXTURES OF STEARIC ACID AND OTHER COMPOUNDS

Mixture	t°	Wt. % $CH_3(CH_2)_{16}COOH$
Stearic Acid + Cyclohexane	6.6	< 0.1
Stearic Acid + Benzene	5.50	0.015
Stearic Acid + Glacial Acetic Acid	16.48	0.03

STEARO, 4 - ANISIDINE, 2 SODIUM SULFATE

Results for the solubility of this compound in Water are given in the form of a diagram showing that above a certain temperature the increase in solubility is extremely rapid with each small increment of temperature. See Note under Cetyl Pyridinium Bromide p.775. (Adams and Fankhurst, 1946).

SODIUM STEARATE $CH_3(CH_2)_{16}COONa$

See also p. 438

SOLUBILITY OF SODIUM STEARATE IN SEVERAL SOLVENTS

(Smith and McBain, 1947)

The determinations were made by the sealed tube method.

The temperatures are those at which, on cooling, anisotropic material began to separate from the homogeneous isotropic solution. After cooling the mixtures were studied visually and by microscopic examinations under polarized light and by photo micrography. These observations are reported in detail.

In Cyclohexane

(Crit. t. 281°)

t°	Wt. % Stearate
115	0.44
160	7.9
195	11.5
222	18.3
232	25.1
240	33.2
243	39.6
> 310	45.4
> 310	52.8
> 300	72.0
> 307	83.0
269	93.3
285	100.

In Toluene

(Crit. t. 320.6°)

133	0.93
165	9.1
225	18.9
244	36.0
235	45.4
287	55.9
331	60.3
335	77.9
257	89.8
264	94.6

In p Xylene

(Crit. t. 348.5°)

t°	Wt. % Stearate
220	19.5
232	28.6
244	43.7
216	56.3
> 280	61.9
261	87.8
263	90.8

In o Xylene

200	10.2
216	19.9
229	27.6
240	38.1

In m Xylene

223	20.9
230	29.4
244	44.1

In Ethyl Benzene

140	1.36
195	10.3
227	19.0
236	27.8
240	37.4
250	46.8
> 291	66.1
258	78.9
258	88.2
260	95.0

In Cumene

t°	Wt. % Stearate
222	11.3
228	23.1
238	33.4
245	43.7

In n Butyl Benzene

193	19.9
226	31.1
239	38.8

In p Cymene

118	9.5
144	19.5
171	27.6

In n Heptane

240	32.2

In Isooctane

248	47.4
258	73.3

In Benzene

222	20.1
> 238	29.9

STEARAMIDE $CH_3(CH_2)_{16}CONH_2$

SOLUBILITY OF STEARAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_{16}CONH_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclohexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	0.3	-	-	0.1	0.2	0.3
30	0.4	0.3	< 0.1	0.3	0.5	0.7
50	1.6	0.4	0.3	2.0	2.0	2.9
60	5.2	0.6	1.6	5.4	3.7(56.5°)	8.2
70	25.0	3.3	10.5	16.6	-	23.6
80	89.0	88.0 (81.4°)	28.4 (76.0°)	41.1 (77.2°)	-	79.0

Gms. $CH_3(CH_2)_{16}CONH_2$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	0.1	0.4	0.2	0.2	0.1	0.1	0.1
30	0.5	0.7	0.8	1.0	1.1	0.2	0.2
50	2.9	3.5	5.7	6.9	7.3	0.5	0.4
60	-	12.7	15.6	20.0	-	-	0.9
70	17.0	23.3 (64.7)	50.0	56.0	44.0	5.2	2.6
80	-	-	124. (78.5)	172. (82.3)	-	-	16.8 (82.0)
90	135.	-	-	-	204.	93.0	-
100	465	-	-	-	590.	61.	-

OCTADECANOL $CH_3(CH_2)_{16}CH_2OH$

SOLUBILITY OF OCTADECANOL IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

Gms. $CH_3(CH_2)_{16}CH_2OH$ per 100 gms. Solvent in:

t°	Benzene	Cyclohexane	Nitro Ethane	Acetonitrile
10	1.2	0.6	-	-
20	4.2	3.2	-	-
30	22.3	18.1	< 0.1	0.3
40	98.	92.	2.7	1.6
50	430	400.	25.4	7.6

Gms. $CH_3(CH_2)_{16}CH_2OH$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone
0	< 0.1	0.1	0.3	-	0.1
10	0.3	0.6	1.7	0.1	1.0
20	1.7	2.8	5.4	1.1	3.8
30	12.0	10.4	17.0	7.0	12.7
40	60.0	49.5	59.0	41.4	62.0

Gms. $CH_3(CH_2)_{16}CH_2OH$ per 100 gms. Solvent in:

t°	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
0	0.2	0.5	-	0.2	< 0.1	1.0
20	6.7	7.7	0.4	5.0	7.7	9.2
30	28.3	26.4	6.6	22.2	29.0	27.7
40	95.0	46.0	146.0	120.0	119.0	89.0

The eutectic of Octadecanol + Benzene is at about 5.5° and 0.8 Wt. % Octadecanol.

The eutectic of Octadecanol + Cyclohexane is at about 6.5° and 0.4 Wt. % Octadecanol.

OCTADECYLAMINE $CH_3(CH_2)_{16}CH_2NH_2$

The temperature-composition relations in the system Octadecylamine - Water are presented in the form of a diagram which shows the boundaries of the several liquid and solid phases, but from which accurate numerical values cannot be deduced. Two hydrates having the compositions $(C_{18}H_{37}NH_2)_3 \cdot H_2O$ and $C_{18}H_{37}NH_2 \cdot 2H_2O$ are formed. (Ralston, Hoerr, and Hoffman, 1942).

SOLUBILITY OF OCTADECYLAMINE IN SEVERAL SOLVENTS

(Ralston, Hoerr, Pool, and Harwood, 1944)

Gms. $CH_3(CH_2)_{16}CH_2NH_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
0	-	-	0.9	1.0	-	-	-
10	4.2	2.8	-	-	-	-	-
20	14.8	13.2	9.5	11.4	-	0.2	-
30	52.	42.9	27.0	30.4	< 0.1	6.3	0.3
40	173.	144.0	100.0	100.0	3.7	85.0	1.9
50	1000.	940.0	845.0	845.0	17.0	1975.0	10.5

Gms. $CH_3(CH_2)_{16}CH_2NH_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-40	-	1.2	-	-	-	-	
-20	< 0.1	3.3	-	-	-	-	
0	0.6	9.4	-	0.6	0.1	0.5	0.4
20	7.7	31.9	4.4	15.6	7.2	30.0	22.7
30	27.9	63.0	22.7	95.0	75.0	80.0	75.0
40	120.0	149.0	46.8	(34.5 ≥ 56.0	280.	228.0	208.
50	835.0	845.0	-	1440.0	1630.	1330.0	1240.

THE EUTECTICS OF MIXTURES OF OCTADECYLAMINE AND OTHER COMPOUNDS

Mixture	t°	Wt. % $CH_3(CH_2)_{16}CH_2NH_2$
Octadecylamine + Benzene	5.2	2.2
Octadecylamine + Cyclohexane	5.6	1.0
Octadecylamine + Tetra Chloro Methane	-	< 0.1

FREEZING-POINTS IN THE SYSTEM OCTADECYLAMINE - ACETIC ACID

(Pool, Harwood, and Ralston, 1945)

t°	Gms. $C_{18}H_{37}NH_2$ per 100 gms. Mixture	Solid Phase
62.6	99.0	1.1
67.9	96.3	"
73.5	85.4	"
79.5	66.7	"
84.4 (m.pt)	50.0	"
80.9	43.1	"
72.7	36.9	"
63.2	31.7	"
62.0	31.2	1.2
60.4	29.2	1.2
51.4	20.2	"
28.0	10.1	"
16.2	5.2	"
14.2 (Eutec)	5.0	1.2 + CH_3COOH
14.8	3.6	CH_3COOH
15.4	2.1	"
16.63	0.0	"

1.1 = $C_{18}H_{37}NH_2 \cdot CH_3COOH$ 1.2 = $C_{18}H_{37}NH_2 \cdot 2CH_3COOH$

Results are also given for the unstable modifications of the 1.1 and 1.2 compounds.

OCTADECYLAMINE HYDROCHLORIDE $CH_3(CH_2)_{16}CH_2NH_2 \cdot HCl$

Results for the solubility of Octadecylamine Hydrochloride in 95 Wt. % Ethanol at temperatures between 20° and 80° are given in the form of a diagram by Harwood, Ralston, and Selby, 1941.

OCTADECYLAMINE ACETATE $CH_3(CH_2)_{16}CH_2NH_2 \cdot CH_3COOH$

Results for the transition temperatures for the system Octadecylamine Acetate - Water are given in the form of a diagram by Ralston, Hoerr, and Hoffman, 1941.

Results for the solubility of Octadecylamine Acetate in 95 Wt. % Ethanol and in Benzene at temperatures between 30° and 70°, are given in the form of diagrams by Harwood, Ralston, and Selby, 1941.

TRIPHENYL CHLORO METHANE $C(C_6H_5)_3Cl$

The Freezing-Points of mixtures of Triphenyl Chloro Methane and Triphenyl Carbinol are given by Funakubo and Matsui, 1937.

THEBAINE $C_{19}H_{21}NO_3$

The distribution coefficient of Thebaine between Ethyl Ether and Water, for a concentration of 13.5 millimols per liter in the ether layer divided by 0.85 millimols per liter in the water layer is 16 at 19°. (Collander, 1949).

CINCHONINE $C_{19}H_{22}N_2O$

SOLUBILITY OF CINCHONINE IN AQUEOUS ETHYL ALCOHOL
(Chowdbry and Bonilla, 1949)

t°	Gms. $C_{19}H_{22}N_2O$ per 100 gms. Saturated Solution in Aq. C_2H_5OH of:					
	50 Vol. %	60 Vol. %	70 Vol. %	80 Vol. %	90 Vol. %	96.6 Vol. %
0	-	0.049	0.0885	0.190	0.394	0.517
10	-	0.075	0.135	0.280	0.540	0.681
15	-	0.092	0.165	0.339	0.626	0.775
20	-	0.114	0.200	0.418	0.725	0.803
25	-	0.136	0.239	0.493	0.833	0.990
28.2	0.0304	0.153	0.271	0.542	0.894	1.080
30	-	0.163	0.286	0.577	0.946	1.130
40	-	0.230	0.404	0.804	1.22	1.41
50	0.15	0.32	0.56	1.09	1.54	1.73
60	-	0.433	0.754	1.45	1.91	2.12
70	-	0.586	1.02	1.91	2.37	2.58

CINCHONIDINE $C_{19}H_{22}N_2O$

SOLUBILITY OF CINCHONIDINE IN AQUEOUS ETHYL ALCOHOL
(Chowdbry and Bonilla, 1949)

t°	Gms. $C_{19}H_{22}N_2O$ per 100 gms. Saturated Solution in Aq. C_2H_5OH of:					
	50 Vol. %	60 Vol. %	70 Vol. %	80 Vol. %	90 Vol. %	96.9 Vol. %
0	0.097	0.46	0.868	1.96	3.48	3.85
10	0.159	0.70	1.26	2.7	4.55	4.97
15	0.202	0.853	1.52	3.15	5.17	5.59
20	0.255	1.04	1.81	3.61	5.84	6.29
25	0.316	1.26	2.15	4.17	6.54	7.06
27.9	0.36	1.38	2.35	4.54	7.02	7.52
30	0.391	1.49	2.5	4.75	7.34	7.83
40	0.585	2.09	3.4	6.1	9.08	9.42
50	0.88	2.89	4.55	7.71	11.02	11.51
60	1.72	3.85	5.84	9.54	13.0	13.6
70	1.73	5.12	7.58	11.8	15.5	16.0

10-NONADECANONE (Caprinone) $[CH_3(CH_2)_8]_2CO$

SOLUBILITY OF 10- NONADECANONE IN SEVERAL SOLVENTS
(Garland, Hoerr, Pool, and Ralston, 1943)

t°	Gms. $[CH_3(CH_2)_8]_2CO$ per 100 gms. Solvent in:					
	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone
10	13.8	8.6	7.5	5.1	6.5	3.1
30	67.5	41.2	32.7	16.2	18.6	10.6
50	510.	482.0	270.0	372.0	295.0	3450.0(56.5°)

t°	Gms. $[CH_3(CH_2)_8]_2CO$ per 100 gms. Solvent in:						
	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Aceto-nitrile	Nitro Ethane
10	4.9	0.6	1.2	1.3	1.6(20°)	0.8	1.6(20°)
30	22.0	1.5	3.2	4.8	19.8(40°)	1.6	1.5(40°)
50	400.0	69.5 ∞ (64.7°)	194.0 ∞ (65°)	198.0 (65°)	350.0 ∞ (60°)	27.0 ∞ (70°)	7.5 230.0(60°)

In the case of Acetonitrile immiscible liquid layers are formed over a considerable range of concentration.

EOSIN (Tetra Bromo Fluorescein, Bromo Acid) $C_{20}H_8Br_4O_5$

SOLUBILITY OF EOSIN (Bromo Acid) IN SEVERAL SOLVENTS AT 20°

(Lower, 1949)

Solvent	Gms. Eosin per 100 gms. Sat. Sol.	Solvent	Gms. Eosin per 100 gms. Sat. Sol.
Furfuryl Alcohol	3.0	Ethylene Ricinolate	1.9
Tetra Hydro Furfuryl Alcohol	22.0	Cyclohexanone	1.6
Tetra Hydro Furfuryl Acetate	28.0	Ethyl Ricinolate Acetate	1.4
Poly Ethylene Glycol "4000"	12.0	Olyl Alcohol	1.0
Poly Ethylene Glycol "1500"	10.0	Ethylene Glycol	1.0
Poly Ethylene Glycol "400"	10.0	Lauryl Alcohol	0.75
Hexo Ethylene Glycol	9.0	Myristyl Alcohol	0.57
Phenyl Ethyl Alcohol	8.0	Stearyl Alcohol	0.5
Diacetone Alcohol	6.5	Glycol Oleate Acetate	0.4
Benzyl Alcohol	6.0	Cocoa Butter	0.35
Tetra Ethylene Glycol	5.7	Lauric Acid	0.3
Hydroxy Citronella	4.5	Myristic Acid	0.3
Cetral	4.5	Cetyl Acetate	0.3
Triethylene Glycol	4.0	Castor Oil	1.8
Acetone	3.7	Ethyl Stearate	0.2
Diphenyl Ketone	3.7	Glycol Oleate	0.1
Diethylene Glycol	2.5	Ethyl Oleate	0.3
Turpeneol	1.9		

ERYTHROSIN (F D and C Red No. 3; Tetra Iodo Fluorescein) $C_{20}H_8I_4O_5$

SOLUBILITY OF F D AND C RED NO. 3 IN WATER

(Zuckerman and Koch, 1946)

Increasing quantities of Erythrosin containing 2% of its weight of NaCl were dissolved by heating in water to 100° and then allowed to stand at 37.5° until no further precipitation occurred. Portions of the clear filtrate were evaporated to dryness and the dissolved dye plus NaCl weighed. The maximum solubility of the dye under these conditions was found to be 12.69%.

PHENOLPHTHALEIN $(OHC_6H_4)_2COC_6H_4CO$

SOLUBILITY OF PHENOLPHTHALEIN IN SEVERAL SOLVENTS AT 25°

(Hubacher, 1945)

Solvent	Gms. $C_{20}H_{14}O_4$ per 100 gms. Solvent	Solvent	Gms. $C_{20}H_{14}O_4$ per 100 gms. Solvent
Pyridine	152.29	Ether (U.S.P.)	1.39
Acetone	28.01	Acetic Acid (99.7%)	0.44
Ethanol (92.4%)	10.37	Ether (pure)	0.48
Ethanol (99.6%)	9.20	Glycerol (95.2%)	0.053
Ethanol (41.5%)	9.17	Chloroform	0.006
Methanol	0.78	Benzene	0.0031
Ethylene Glycol	2.14	Water	0.0002

BERBERINE $C_{20}H_{17}NO_4 \cdot 6H_2O$

The distribution coefficient of Berberine between Ethyl Ether and Water, for a concentration of less than 0.05 millimol per liter in the ether layer divided by 10 millimols per liter in the water layer is less than 0.005 at 18°. (Collander, 1949).

QUININE $C_{20}H_{24}N_2O_2 \cdot 3H_2O$

The distribution coefficient of Quinine between Ethyl Ether and Water, for a concentration of 36 millimols per liter in the ether layer divided by 0.82 millimol per liter in the water layer is 44 at 20°. (Collander, 1949).

Correction to Vol. 2, 3rd. Ed. Solubilities, p.803, in the table showing results of Treadwell, the column headings H_2O Layer and Ethereal Layer should be reversed.

QUININE SALTS

SOLUBILITY OF QUININE SALTS IN WATER AT 20°

(Johnson, 1937)

In order to obtain more soluble and less acid Quinine Salts, a series of double salts were prepared in which weakly dissolved organic acids were attached to the quinoline nitrogen of Quinine Hydrochloride. In the following double salts the first acid is that attached to the quinuclidine N and the second acid is that attached to the quinoline N.

Double Salt	Gms. Double Salt per 100 cc Sat. Sol.
$C_{20}H_{24}N_2O_2 \cdot HCl \cdot CH_3COOH$	10.84
$C_{20}H_{24}N_2O_2 \cdot CH_3COOH \cdot HCl$	72.40
$C_{20}H_{24}N_2O_2 \cdot CH_3COOH \cdot CH_3COOH$	2.15
$C_{20}H_{24}N_2O_2 \cdot HCOOH \cdot HCOOH$	4.0
$C_{20}H_{24}N_2O_2 \cdot HCl \cdot C_2H_5COOH$	10.47
$C_{20}H_{24}N_2O_2 \cdot HCl \cdot C_4H_9COOH$	11.87
$C_{20}H_{24}N_2O_2 \cdot HCl \cdot CH_3CHOHCOOH$	114.9 (?)

DIAMYL NAPHTHALENE $C_{10}H_6[CH_3(CH_2)_4]_2$

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF DIAMYL NAPHTHALENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	262	m Dinitro Benzene	< 78
Triethylene Glycol	246	2,4 Dinitro Chloro Benzene	51
p Nitro Aniline	230	Nitro Methane	95
p Amino Phenol	220	m Nitro Acetophenone	56
o Nitro Benzoic Acid	200	Benzyl p Hydroxy Benzoate	< 80
m Amino Phenol	195	Furfuryl Alcohol	88
p Amino Acetophenone	162	Chloro Acetic Acid	108
Ethylene Diformate	181	Phenyl Hydrazine	79
Maleic Anhydride	184	Acetonitrile	84
p Amino Benzophenone	130	Ethylene Chlorohydrin	68
Aceto Acetanilide	148	Furfural	23
2,4 Dinitro Phenol	117	Acetic Anhydride	44
p Amino Ethyl Acetanilide	135	Ethylene Diacetate	32
Catechol	136	Tetrahydro Furfuryl Alcohol	9
Antipyrine	100	Aniline	12
Methyl Sulfate	111	Acetonyl Acetone	0
Phenyl Ethanol Amine	98		

PALMITANILIDE $CH_3(CH_2)_{12}CONH(C_6H_5)$

SOLUBILITY OF PALMITANILIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

t°	Gms. $CH_3(CH_2)_{12}CONH(C_6H_5)$ per 100 gms. Solvent in:					
	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	1.0	0.4	1.0	0.7	1.1	2.7
30	2.2	0.6	1.2	3.0	3.3	6.6
50	30.5	2.4	20.2	17.2	22.1	33.5
60	97.	61.0	86.0	52.0	52.9(56.5°)	89.
70	222.	173.0	235.	159.	-	208.
80	640.	535.(81.4°)	408 (76.0°)	410.(77.2°)	-	600.

t°	Gms. $CH_3(CH_2)_{12}CONH(C_6H_5)$ per 100 gms. Solvent in:						
	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	1.0	0.5	0.6	0.6	1.8	0.5	0.3
30	4.3	0.8	2.2	2.4	5.5	0.8	0.7
50	18.9	6.3	14.2	14.2	21.6	3.4	2.2
60	-	25.4	49.5	39.5	-	-	5.5
70	116.	68.(64.7°)	205.	147.0	152.0	41.8	32.5
80	-	-	720.(78.5)	1050 (82.3°)	-	-	733.(82.0°)
90	∞	-	-	-	∞	∞	-

TETRAAMYL AMMONIUM IODIDE $N[CH_3(CH_2)_3CH_2]_4I$

SOLUBILITY OF TETRAAMYL AMMONIUM IODIDE IN BENZENE SOLUTIONS OF TETRAAMYL AMMONIUM PICRATE AND OF TRIBUTYL AMMONIUM PICRATE AT 25°

(Vernon and Masterson, 1942)

Results for Benzene Solutions of:

Tetraamyl Ammonium Picrate Moles per liter		Tributyl Ammonium Picrate Moles per liter	
Picrate	Iodide	Picrate	Iodide
0.0000	0.0000539	0.0001	0.000107
0.0001	0.0000583	0.0003	0.000204
0.0005	0.0000992	0.0010	0.000385
0.0010	0.000143	0.0030	0.000739
0.0020	0.000250	0.0050	0.001065

TETRAISOAMYL AMMONIUM IODIDE $N[(CH_3)_2CH(CH_2)_2]_4I$

SOLUBILITY OF TETRAISOAMYL AMMONIUM IODIDE IN BENZENE SOLUTIONS OF TETRAISOAMYL AMMONIUM PICRATE AND OF TRIBUTYL AMMONIUM PICRATE AT 25°

(Vernon and Masterson, 1942)

Results for Benzene Solutions of:

Tetraisoamyl Ammonium Picrate Moles per liter		Tributyl Ammonium Picrate Moles per liter	
Picrate	Iodide	Picrate	Iodide
0.000128	0.000132	0.0000	0.000113
0.000253	0.000148	0.000348	0.000328
0.000506	0.000194	0.000695	0.000474
0.001013	0.000295	0.001390	0.000730
0.001500	0.000397	0.002778	0.001124
0.002000	0.000519		
0.002533	0.000689		

STRYCHNINE ACID SULFATE $(C_{21}H_{22}N_2O_2)_2 \cdot H_2SO_4 \cdot 5H_2O$

SOLUBILITY OF STRYCHNINE ACID SULFATE IN CONCENTRATED AQUEOUS SOLUTIONS OF SULFURIC ACID AT 20°

(Zwicker and Robinson, 1941)

Gms. H_2SO_4 per 100 gms. Aq. Solvent	Gms. $C_{21}H_{22}N_2O_2$ per 100 gms. Solvent	Gms. H_2SO_4 per 100 gms. Aq. Solvent	Gms. $C_{21}H_{22}N_2O_2$ per 100 gms. Solvent
19.4	0.237	31.1	0.051
23.0	0.139	35.3	0.133
25.4	0.095	40.9	0.237
27.8	0.029	48.3	0.569
28.5	0.029	59.7	10.29 +

OCTADECYL TRIMETHYL AMMONIUM CHLORIDE $N[CH_3(CH_2)_{17}](CH_3)_3Cl$

SOLUBILITY OF OCTADECYL TRIMETHYL AMMONIUM CHLORIDE IN SEVERAL SOLVENTS

(Reck, Harwood, and Ralston, 1947)

Gms. $N[CH_3(CH_2)_{17}](CH_3)_3Cl$ per 100 gms. Solvent in:

t°	93.5 Wt. % Ethanol	Methanol	Acetonitrile	Carbon Tetrachloride	Acetone
-10	3.7	5.7	-	-	-
0	9.3	15.4	-	-	-
+10	25.6	32.5	-	-	-
20	43.1	71.6	0.7	-	-
30	82.9	112.8	1.8	-	-
40	132.3	168.0	3.2	-	-
50	209.8	252.1	5.1	0.402(55°)	0.503(50°)
60	-	-	9.9	5.04	0.706(55°)
70	-	-	32.7	36.2 (65°)	0.756(56.5°)
80	-	-	73.6	-	-

Results for the solubility of Octadecyl Trimethyl Ammonium Chloride in Chloroform, Ethyl Acetate, and in Benzene are given in the form of a diagram.

N, N - DIPHENYL CAPRAMIDE $CH_3(CH_2)_8CON(C_6H_5)_2$

SOLUBILITY OF DIPHENYL CAPRAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_8CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	100.	64.	72.	68.	96.	78.
30	329.	255.	310.	302.	735.	337.
50	∞	∞	∞	∞	∞	∞

Gms. $CH_3(CH_2)_8CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	54	32	48.4	51	57	57	39.3
30	221	200	275.	224	226	310	252.
50	∞	∞	∞	∞	∞	∞	∞

STEARANILIDE $CH_3(CH_2)_{14}CONH(C_6H_5)$

SOLUBILITY OF STEARANILIDE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and Pool, 1943)

t°	Gms. $CH_3(CH_2)_{14}CONH(C_6H_5)$ per 100 gms. Solvent in: Benzene	Cyclohexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	0.7	0.3	0.4	0.4	0.7	0.8
30	1.5	0.4	0.5	1.8	2.0	2.2
50	14.1	1.1	7.0	8.8	13.0	14.0
60	56.	17.7	43.3	22.7	28.5(56.5°)	47.0
70	145.	105.	167.	93.	-	121.0
80	555.	308.(81.4°)	300 (76.0°)	266.(77.2°)	-	327.
90	-	-	-	-	-	-

t°	Gms. $CH_3(CH_2)_{14}CONH(C_6H_5)$ per 100 gms. Solvent in: Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	0.4	0.1	0.3	0.3	0.6	0.4	0.2
30	1.8	0.2	1.2	1.3	3.2	0.6	0.5
50	8.7	1.0	7.7	8.4	11.2	2.0	1.4
60	-	6.7	21.6	25.8	-	-	3.3
70	68.	16.1(64.7°)	77.	91.0	85.0	14.2	13.8
80	-	-	124.(78.5°)	570.(82.3°)	-	-	480.(82.0°)
90	930	-	-	-	1450.	1060.	-
100	∞	-	-	-	∞	∞	-

l ASCORBYL PALMITATE $C_{22}H_{38}O_7$

SOLUBILITY OF l ASCORBYL PALMITATE IN SEVERAL SOLVENTS AT 25°
(Swern, 1941)

Solvent	Gms $C_{22}H_{38}O_7$ per 100 gms. Solvent	Solvent	Gms. $C_{22}H_{38}O_7$ per 100 gms. Solvent
Water	0.31 - 0.56	Dioxane	19.0
Ethanol (95%)	23.5	Ethyl Acetate	4.9
Benzene	0.45	Ethyl Cellosolve	> 33.0
Ethylene Glycol	0.18	Peanut Oil	0.18(0.12)
1, 2 Propylene Glycol	6.6	Cottonseed Oil	0.22(0.08)

The results in parentheses are for l Ascorbyl Laurate $C_{18}H_{30}O_7$

QUINACRINE HYDROCHLORIDE $C_{23}H_{30}ON_3Cl \cdot 2HCl \cdot 2H_2O$

SOLUBILITY OF QUINACRINE HYDROCHLORIDE IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID AT 27°

(Jones, Shaw, and Waldo, 1945)

The results are given only in the form of a diagram from which the following approximate values were read.

Wt. % Aqueous HCl	Gms. Quinacrine·HCl per 100 cc	Wt. % Aqueous HCl	Gms. Quinacrine·HCl per 100 cc
0.5	1.8	10.0	0.08
1.0	0.6	15.	0.27
1.5	0.2	17.	0.55
5.0	0.08	23.	0.4
7.5	0.06	31	0.2
		40	0.08

Results are also given in the form of diagrams for the solubility of Quinacrine·HCl in 1% HCl at temperatures up to 50° and in Aqueous Acetone containing 1 to 5% HCl at 0° and at 27°.

TRICOSANONE (Laurone) $[CH_3(CH_2)_{10}]_2CO$

SOLUBILITY OF TRICOSANONE IN SEVERAL SOLVENTS

(Garland, Hoerr, Pool, and Ralston, 1943)

Gms. $[CH_3(CH_2)_{10}]_2CO$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone
10	1.2	1.6	1.8	0.4	0.6	0.6
30	20.3	12.7	11.7	2.2	3.7	3.4
50	142.	118.0	73.3	45.4	48.8	62.0
80	∞	∞	∞ (76.0°)	∞ (77.2°)	∞ (77.2°)	∞

Gms. $[CH_3(CH_2)_{10}]_2CO$ per 100 gms. Solvent in:

t°	2-Butanone	Methanol	95 Wt.·% Ethanol	Iso-propanol	n Butanol	Aceto-nitrile	Nitro Ethane
10	0.6	0.1	0.2	0.3	0.4	< 0.1	0.5 (20°)
30	3.4	0.5	0.6	0.8	1.2	0.4	1.5 (40°)
50	62.0	1.7	6.0	10.3	16.2	1.2	7.5
80	∞	23. (64.7°)	900.0 (65°)	720.0 (65°)	730.0 (65°)	12.4 (70°) 22.8 (82°)	230.0 (60°)

In the case of Acetonitrile, immiscible liquid layers are formed over a considerable range of concentration.

N, N - DIPHENYL LAURAMIDE $CH_3(CH_2)_{10}CON(C_6H_5)_2$

SOLUBILITY OF DIPHENYL LAURAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_{10}CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	56	27.2	37.9	25.5	46.8	41.5
30	179	119.	147.	125.	192.	162.
50	915	800.	1065.	1075.	1350.	1250.
60	∞	∞	∞	∞	∞ (56.5°) ∞	

Gms. $CH_3(CH_2)_{10}CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	24.4	9.0	14.7	21.5	25.8	29.0	12.6
30	92.	81.	53.	77.	84.	118.	75.0
50	750	965.	900.	990.	760.	1100.	1075.
60	∞ (70°) ∞		∞	∞	∞ (70°)	∞ (70°)	∞

TRIOCTYL AMINE $[CH_3(CH_2)_6CH_2]_3N$

SOLUBILITY OF TRIOCTYL AMINE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and DuBrow, 1944)

Gms. $[CH_3(CH_2)_7]_3N$ per 100 gms. Solvent in:

t°	Trichloro Methane	Ethyl Ether	Ethyl Acetate	Butyl Acetate	n Butanol
-60	134	58	-	11.5	8.1
-50	287	147	0.1	22.7	15.5
-40	1000	600	4.2	325.	220.0
-30	∞	∞	14.1	∞	∞

Gms. $[CH_3(CH_2)_7]_3N$ per 100 gms. Solvent in:

t°	Acetone	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol
-50	-	0.1	-	-	5.0
-40	0.2	5.9	< 0.1	0.1	17.0
-30	1.2	14.3	0.2	0.3	∞
-20	1.7	37.0	0.3	0.4	-
0	3.7	∞	0.4	0.6	-

EUTECTICS OF MIXTURES OF TRIOCTYL AMINE AND OTHER COMPOUNDS

Mixture	t°	Wt. % $[CH_3(CH_2)_7]_3N$
Trioctyl Amine + Benzene	-38.5	91.0
Trioctyl Amine + Cyclohexane	-16.5	17.0
Trioctyl Amine + Tetra Chloro Methane	-60.1	37.5

Trioctyl Amine forms immiscible layers between certain concentrations of Ethyl Acetate and 2-Butanone. These data and the freezing-points with Cyclohexane, Benzene and Tetra Chloro Methane are shown in the diagrams of the results.

DIDOCYL AMINE $NH[CH_2(CH_3)_{11}]_2$

SOLUBILITY OF DIDOCYL AMINE IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

This compound exists in two crystalline forms with melting points; 46.9° for the α form and 51.8° for the β form. The solubility results are for the higher melting modification.

Gms. $NH[CH_2(CH_3)_{11}]_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
10	3.3	2.2	-	-	-	-	-
20	14.6	12.4	1.5	5.4	-	1.3	-
30	54.0	46.0	10.5	26.4	1.8	13.0	-
40	205.	182.	141.0	165.0	18.7	178.	0.2
50	2400.	2340.	3230.0	3230.	3900.	4650.	1.9
60	∞	∞	∞	∞	∞	∞	2.4
							3.2(70°)

Gms. $NH[CH_2(CH_3)_{11}]_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-10	0.7	4.8	-	-	-	-	0.4
0	-	-	0.2	-	-	-	-
+10	5.9	19.2	2.1	-	0.2	2.6	3.4
20	15.0	37.4	9.1	-	-	-	-
30	34.0	72.0	32.5	4.3	19.5	55.0	62.
40	89.	162.0	50.(34.5°)	710.	185.	297.	312.
50	849.	1275.0	-	5780.	3350.	4080.	4250.
60	∞	∞	-	∞	∞	∞	∞

N, N-DIPHENYL PALMITAMIDE $CH_3(CH_2)_{12}CON(C_6H_5)_2$

SOLUBILITY OF N, N-DIPHENYL PALMITAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1943)

Gms. $CH_3(CH_2)_{12}CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	18.8	9.2	16.0	7.7	12.0	13.1
30	81.	38.5	44.7	24.7	45.5	52.0
50	283.	232.	240.	182.0	298.0	268.0
60	720	660.	820.	610.	630.(56.5°)	800.
70	∞	∞	∞	∞	-	∞

Gms. $CH_3(CH_2)_{12}CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	8.2	1.7	1.1	6.6	7.5	16.1	1.5
30	24.8	5.6	5.0	13.4	19.0	29.0	5.8
50	158.	102.	100.	90.0	108.0	179.0	75.0
60	-	525.	565.	452.0	-	-	635.0
70	∞	1400.(64.7°)	∞	∞	∞	∞	∞

GLYCOCHOLIC ACID $C_{24}H_{39}O_4NH\cdot CH_2COOH$

SOLUBILITY OF GLYCOCHOLIC ACID IN WATER

(Emich, 1882)

These results were erroneously recorded under Glycolic Acid on page 117 of the 3rd. Ed., Vol. 2 of Solubilities.

t°	Gms. $C_{26}H_{43}O_6N$ per 1000 gms. Sat. Sol.
20	0.33
60	1.02
80	2.35
100	8.5

SOLUBILITY OF GLYCOCHOLIC ACID IN AQUEOUS SOLUTIONS OF ETHYL ALCOHOL AND OF TAUROCHLORIC ACID AT 20°

(Emich, 1882)

In Ethyl Alcohol				In Taurochloric Acid	
Wt. % C_2H_5OH	Gms. $C_{26}H_{43}O_6N$ per 1000 gms. Sat. Sol.	Wt. % C_2H_5OH	Gms. $C_{26}H_{43}O_6N$ per 1000 gms. Sat. Sol.	Wt. % Taurochloric Acid	Gms. $C_{26}H_{43}O_6N$ per 1000 gms. Sat. Sol.
1.0	0.35	20.	2.75	1.0	0.50
2.0	0.49	30	16.74	5.0	3.7
10.0	1.00	50	27.53	10.0	6.9

1000 gms. Sat. Sol. in Ethyl Ether contain 0.93 gms. $C_{26}H_{43}O_6N$ at 20°

1000 gms. Sat. Sol. in Benzene contain 0.09 gms. $C_{26}H_{43}O_6N$ at 20°

1000 gms. Sat. Sol. in Chloroform contain 0.11 gms. $C_{26}H_{43}O_6N$ at 20°

DITRIDECYL AMINE $NH[CH_2(CH_3)_{12}]_2$

SOLUBILITY OF DITRIDECYL AMINE IN SEVERAL SOLVENTS
(Hoerr, Harwood, and Ralston, 1944)

	Gms. $NH[CH_2(CH_3)_{12}]_2$ per 100 gms. Solvent in:						
t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
10	1.7	1.0	-	-	-	-	-
20	8.0	6.3	0.2	0.9	-	< 0.1	-
30	31.4	24.5	3.4	6.9	< 0.1	3.8	-
40	116.0	101.	29.4	37.3	5.2	29.7	-
50	505	500.	475.	475.0	505.0	795.0	0.5
60	∞	∞	∞	∞	∞ (56.1°)	∞	1.4 2.0(70°)

	Gms. $NH[CH_2(CH_3)_{12}]_2$ per 100 gms. Solvent in:						
t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-10	0.3	2.5	-	-	-	-	-
+10	3.8	11.5	0.1	-	-	-	1.0
20	10.0	24.4	3.9	-	-	-	-
30	24.5	50.0	19.6	-	4.5	9.8	18.2
40	61.0	106.	37.5(34.5°)	7.2	43.1	79.	103.
50	220.0	325.	-	32.1	655.	740.	700.
60	-	-	-	38.5	∞	∞	∞

CHOLESTEROL $C_{27}H_{45}OH$
PHYTOSTEROL $C_{27}H_{45}OH$

Freezing-point data for mixtures of Cholesterol and Palmitin and of Phytosterol and Palmitin are given by Efremov, Vinogradova, and Tichomirova, 1937.

HEPTACOSANONE (Myristone) $[CH_3(CH_2)_{12}]_2CO$

SOLUBILITY OF HEPTACOSANONE IN SEVERAL SOLVENTS
(Garland, Hoerr, Pool, and Ralston, 1943)

	Gms. $[CH_3(CH_2)_{12}]_2CO$ per 100 gms. Solvent in:					
t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone
10	0.3	0.2	0.3	0.1	0.1	< 0.1
30	6.3	4.1	4.5	0.3	0.8	0.4
50	67.4	47.9	34.5	8.9	12.1	2.7(56.5°)
80	∞	∞ (81.4°)	2760.0(76°)	∞ (77.2°)	∞ (77.2°)	-

Gms. $[CH_3(CH_2)_{12}]_2CO$ per 100 gms. Solvent in:

t°	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Aceto-nitrile	Nitro Ethane
10	0.1	-	< 0.1	< 0.1	< 0.1	-	0.1(20°)
30	0.5	0.1	0.1	0.1	0.1	0.1	0.2(40°)
50	10.6	0.4	0.8	1.9	4.4	0.2	0.9
80	∞	1.9(64.7°)	13.8(65°)	25.3(65°)	42.9(65°)	4.1(70°) 8.1(82°)	5.6(60°)

In the case of Acetonitrile, two liquid layers are formed over a considerable range of concentration.

N, N-DIPHENYL STEARAMIDE $CH_3(CH_2)_{14}CON(C_6H_5)_2$

SOLUBILITY OF DIPHENYL STEARAMIDE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Pool, 1948)

Gms. $CH_3(CH_2)_{14}CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Acetone	2-Butanone
10	11.	6.0	10.5	3.9	5.0	5.6
30	65	25.0	30.1	13.6	10.6	23.9
50	230	172.	166.	124.0	185.0	147.0
60	520	460.	485.	378.0	390.(56.5°)	432.0
70	3500	2850	3800.	3125.0	-	3450.

Gms. $CH_3(CH_2)_{12}CON(C_6H_5)_2$ per 100 gms. Solvent in:

t°	Butyl Acetate	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Nitro Ethane	Aceto-nitrile
10	5.6	1.1	0.8	4.3	4.9	10.9	0.6
30	16.8	3.9	2.6	10.9	13.7	17.8	2.4
50	110.	37.2	52.0	41.6	68.0	92.0	23.9
60	-	300.	310.0	232.	-	-	359.
70	2350.	600.(64.7)	3350.	2525.	2500.	3100.	3350.

DITETRADECYL AMINE $NH[CH_2(CH_3)_{13}]_2$

SOLUBILITY OF DITETRADECYL AMINE IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

Gms. $NH[CH_2(CH_3)_{13}]_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
10	0.9	0.4	-	-	-	-	-
20	4.3	3.1	-	-	-	-	-
30	18.9	14.8	1.1	1.7	-	0.5	-
40	74.	62.0	7.9	10.5	1.1	9.4	-
50	248.	235.	131.0	131.0	22.5	222.0	-
60	∞	∞	∞	∞	900.0(56.1°)	∞	1.0 1.4(70°)

Gms. $NH[CH_2(CH_3)_{13}]_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-10	0.1	1.1	-	-	-	-	-
+10	2.3	6.5	-	-	-	-	0.1
20	6.3	15.7	1.2	-	-	-	-
30	17.1	36.2	10.5	-	0.4	0.6	6.4
40	43.2	79.0	20.4(34.5°)	-	7.8	13.9	31.9
50	122.0	195.0	-	14.0	233.0	269.0	250.0
60	-	-	-	17.0	∞	∞	∞

DIPENTADECYL AMINE $NH[CH_2(CH_3)_{14}]_2$

SOLUBILITY OF DIPENTADECYL AMINE IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

Gms. $NH[CH_2(CH_3)_{14}]_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Aceto-nitrile
10	0.5	0.1	-	-	-	-	-
20	2.8	1.5	-	-	-	-	-
30	10.8	7.9	< 0.1	0.1	-	-	-
40	50.0	40.6	2.5	2.5	< 0.1	3.6	-
50	170.0	152.0	40.8	40.8	6.4	55.0	-
60	1130.0	1100.0	1050.0	1050.0	310.(56.1°)	2170.0	0.3 1.0(70°)

Gms. $NH[CH_2(CH_3)_{14}]_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
-10	-	0.5	-	-	-	-	-
+10	1.4	4.3	-	-	-	-	-
20	4.4	11.5	0.1	-	-	-	-
30	12.0	26.7	5.7	-	-	-	1.0
40	32.1	50.0	12.5(34.5°)	-	1.8	2.6	11.2
50	84.0	139.0	-	2.5	66.0	71.0	100.0
60	-	-	-	8.0	1640.0	1700.0	1320.0

HENTRIACONTANONE (Palmitone) $[CH_3(CH_2)_{14}]_2CO$

SOLUBILITY OF HENTRIACONTANONE IN SEVERAL SOLVENTS

(Garland, Hoerr, Pool, and Ralston, 1943)

Gms. $[CH_3(CH_2)_{14}]_2CO$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone
10	0.1	< 0.1	0.1	-	-	-
30	1.7	1.4	1.3	< 0.1	0.4	0.1
50	27.7	20.	18.2	2.5	3.8	1.0(56.5°)
80	1200.0	1390.(81.4°)	260.(76°)	380.(77.2°)	325.(77.2°)	-

Gms. $[CH_3(CH_2)_{14}]_2CO$ per 100 gms. Solvent in:

t°	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Aceto-nitrile	Nitro Ethane
30	0.1	-	-	-	< 0.1	-	-
50	2.6	0.1	0.2	0.1	0.9	0.1	< 0.1
65	-	0.9 (64.7°)	2.7	5.0	10.7	1.0 (70°)	0.2 (60°)
80	810.0	-	69.5 (78.5°)	2530. (82.3°)	790.0	3.3 (82°)	965.0

BRUCINE $C_{32}H_{26}O_4N_2$

The distribution coefficient of Brucine between Ethyl Ether and Water, for a concentration of 1.03 millimol per liter in the ether layer divided by 5.58 millimols per liter in the water layer is 0.18 at 18°. (Collander, 1949).

CERVADIN $C_{32}H_{49}O_9N$

The distribution coefficient of Cervadin between Ethyl Ether and Water, for a concentration of 77 millimols per liter of the ether layer divided by 0.27 millimol per liter in the water layer is 280 at 18°. (Collander, 1949).

DOTRIACONTANE (Dicetyl) $CH_3(CH_2)_{30}CH_3$

SOLUBILITY OF DOTRIACONTANE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and Crews, 1944)

Gms. $CH_3(CH_2)_{30}CH_3$ per 100 gms. Solvent in:

t°	Benzene	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether
20	0.6	3.6	1.4	0.3	1.7
30	4.2	11.0	5.8	3.1	6.0
40	19.0	36.8	20.0	14.8	-
50	97.0	115.0	64.	71.	-
60	400.	400.	224.	250.	-
70	∞	∞	∞	-	-

Gms. $CH_3(CH_2)_{30}CH_3$ per 100 gms. Solvent in:

t°	Ethyl Acetate	Butyl Acetate	Acetone	2-Butanone	Iso-propanol	n Butanol
30	-	< 0.1	-	-	-	-
40	0.2	1.0	-	0.2	-	-
50	2.3	8.0	< 0.1	2.5	0.2	0.9
60	115.0	180.	-	75.0	2.2	9.2
70	∞	∞	-	∞	12.2	∞

The eutectic of mixtures of Dotriacontane and Cyclohexane is at 6.5° and 0.5 percent Dotriacontane.

SOLUBILITY OF DOTRIACONTANE IN SEVERAL SOLVENTS

(Hildebrand and Wachter, 1949)

Results for the Solubility in:

$SnBr_4$		CCl_4		$n\ CH_3(CH_2)_5CH_3$		$i\ C_8H_{18}$ (1)	
t°	Gms. $C_{32}H_{66}$ per 100 gms. $SnBr_4$	t°	Gms. $C_{32}H_{66}$ per 100 gms. CCl_4	t°	Gms. $C_{32}H_{66}$ per 100 gms. $n\ C_7H_{16}$	t°	Gms. $C_{32}H_{66}$ per 100 gms. $i\ C_8H_{18}$
26.8	0.46	21.3	2.04	28.4	4.11	21.7	0.84
44.8	1.87	24.3	3.15	29.8	4.98	29.6	2.86
48.5	3.92	27.1	5.15	34.2	8.68	32.6	3.96
48.8	4.33	35.0	12.6	35.0	10.23	37.4	8.97
50.8	6.42	37.5	17.0	39.0	20.8	39.0	11.7
52.1	8.51	42.8	31.9	43.0	36.0	40.8	15.8
56.0	20.1	44.7	37.0	44.6	44.2	40.9	16.0
		50.6	70.5			42.9	23.8
		53.0	87.6			53.6	108.0

CS_2		C_6H_6		$SnCl_4$		$(C_2H_5)_2O$	
t°	Gms. $C_{32}H_{66}$ per 100 gms. CS_2	t°	Gms. $C_{32}H_{66}$ per 100 gms. C_6H_6	t°	Gms. $C_{32}H_{66}$ per 100 gms. $SnCl_4$	t°	Gms. $C_{32}H_{66}$ per 100 gms. $(C_2H_5)_2O$
17.4	2.03	24.6	1.55	30.1	1.31	32.5	4.44
20.6	4.17	30.3	4.60	37.8	4.02	38.3	12.0
25.9	10.5	37.3	17.0	40.8	9.12	45.6	41.0
31.7	23.9	41.6	36.0	53.8	38.3	47.1	56.0
45.9	103.5	51.6	136.1				

(1) = 2, 2, 4 - Trimethyl Pentane (Isooctane)

HEMIN $C_{32}H_{32}N_4FeO_4$

FERRIHEMIC ACID $C_{32}H_{33}N_4FeO_5$

The solubility of Hemin and Ferrihemic Acid, each separately, in aqueous solutions of NaOH and KOH was determined up to a concentration of 80.4 millimols NaOH per liter, at which concentration there was dissolved 26.8 mM of Hemin and 27.6 mM Ferrihemic Acid at 30°.

The results of solubility and titration experiments show that 3 equiv. of base are required to dissolve Hemin with formation of soluble dialkali Ferrihemate and Alkali Chloride.

The calculated solubilities are, for:

Hemin	1.36×10^{-6} mole or 0.0009 gm. per liter.
Ferrihemic Acid	1.63×10^{-6} mole or 0.0010 gm. per liter.

(Morrison and Williams Jr., 1941)

PENTATRIACONTANONE (Stearone) $[CH_3(CH_2)_{16}]_2CO$

SOLUBILITY OF PENTATRIACONTANONE IN SEVERAL SOLVENTS
(Garland, Hoerr, Pool, and Ralston, 1943)

Gms. $[CH_3(CH_2)_{16}]_2CO$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Ethyl Acetate	Butyl Acetate	Acetone
10	< 0.1	< 0.1	< 0.1	-	-	-
30	0.6	0.5	0.2	-	0.2	< 0.1
50	12.7	9.3	9.8	0.1	0.9	0.4(56.5°)
80	383.	480.(81.4°)	133.(76°)	120.(77.2°)	125.(77.2°)	-

Gms. $[CH_3(CH_2)_{16}]_2CO$ per 100 gms. Solvent in:

t°	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol	Aceto-nitrile	Nitro Methane
50	0.5	-	< 0.1	-	< 0.1	< 0.1	< 0.1(50°)
65	-	0.3(64.7°)	0.4	0.6	1.8	0.7(70°)	0.2(60°)
80	290.	-	4.9(78.5°)	58.0(82.3°)	106.0	1.1(82°)	150.0

TRIDODECYL AMINE $[CH_3(CH_2)_{11}]_3N$

SOLUBILITY OF TRIDODECYL AMINE IN SEVERAL SOLVENTS
(Ralston, Hoerr, and DuBrow, 1944)

Gms. $[CH_3(CH_2)_{11}]_3N$ per 100 gms. Solvent in:

t°	Benzene	Cyclo-hexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Ethyl Acetate	Butyl Acetate
-20	-	-	6.3	7.6	4.2	-	1.5
-10	-	-	16.5	26.8	13.5	0.2	3.9
0	-	-	43.2	106.	54.0	1.0	11.4
+10	570	570	188.	490.	315.0	850.0	900.0

Gms. $[CH_3(CH_2)_{11}]_3N$ per 100 gms. Solvent in:

t°	Acetone	2-Butanone	Methanol	95 Wt. % Ethanol	Iso-propanol	n Butanol
0	-	0.5	-	-	< 0.1	1.5
10	0.1	9.8	< 0.1	-	2.7	25.5
20	1.4	∞	0.3	0.2	15.3	∞
30	2.2	-	0.5	0.7	23.9	-
40	3.4	-	1.2	1.5	58.0	-

EUTECTICS OF MIXTURES OF TRIDODECYL AMINE AND OTHER COMPOUNDS

Mixture	t°	Wt. % $[CH_3(CH_2)_{11}]_3N$
Tridodecyl Amine + Benzene	+0.3	42.5
Tridodecyl Amine + Cyclohexane	-12.5	27.6
Tridodecyl Amine + Tetrachloro Methane	-23.7	3.9

DIOCTADECYL AMINE $NH[CH_2(CH_3)_{17}]_2$

SOLUBILITY OF DIOCTADECYL AMINE IN SEVERAL SOLVENTS

(Hoerr, Harwood, and Ralston, 1944)

Gms. $NH[CH_2(CH_3)_{17}]_2$ per 100 gms. Solvent in:

t°	Benzene	Cyclohexane	Ethyl Acetate	Butyl Acetate	2-Butanone	Acetone	Acetonitrile
20	0.2	< 0.1	-	-	-	-	-
30	2.2	1.1	-	-	-	-	-
40	16.4	13.1	< 0.1	-	-	-	-
50	71.0	65.0	2.2	2.1	1.8	0.1	-
60	226.0	214.0	78.0	43.6	25.8	2.0(56.1°)	< 0.1 0.7(70°)

Gms. $NH[CH_2(CH_3)_{17}]_2$ per 100 gms. Solvent in:

t°	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether	Methanol	95 Wt. % Ethanol	Isopropanol	n Butanol
10	0.2	0.5	-	-	-	-	-
20	1.2	2.8	-	-	-	-	-
30	4.6	9.8	0.3	-	-	-	-
40	15.1	25.4	1.7(34.5°)	-	-	-	0.2
50	40.0	62.0	-	-	0.1	1.2	5.4
60	-	-	-	0.6	4.9	13.4	63.0

TRIOCTADECYL AMINE $[CH_3(CH_2)_{17}]_3N$

SOLUBILITY OF TRIOCTADECYL AMINE IN SEVERAL SOLVENTS

(Ralston, Hoerr, and DuBrow, 1944)

Gms. $[CH_3(CH_2)_{17}]_3N$ per 100 gms. Solvent in:

t°	Benzene	Cyclohexane	Tetra Chloro Methane	Trichloro Methane	Ethyl Ether
0	-	-	1.5	0.9	< 0.1
10	0.5	2.0	5.2	4.1	1.6
20	4.2	18.6	13.0	13.5	8.1
30	49.2	77.0	33.5	40.6	28.8
40	168.0	202.0	81.0	117.0	-
50	840.0	950.0	335.0	650.0	-
60	∞	∞	∞	∞	-

Gms. $[CH_3(CH_2)_{17}]_3N$ per 100 gms. Solvent in:

t°	Ethyl Acetate	Butyl Acetate	2-Butanone	Isopropanol	n Butanol
20	< 0.1	0.1	-	-	-
30	0.4	2.4	0.1	-	-
40	3.2	15.1	2.4	< 0.1	0.2
50	1550.0	1550.0	1250.0	2.0	17.0
60	∞	∞	∞	5.3	∞

The eutectic of Trioctadecyl Amine + Benzene is at 5.5° and 0.2 Wt. % Amine
The eutectic of Trioctadecyl Amine + Cyclohexane is at 6.5° and 0.1 Wt. % Amine

ALOE - EMODIN

SOLUBILITY OF ALOE-EMODIN IN 0.1 M BORAX-SODIUM CARBONATE BUFFERS AT 25°
(Stone and Furman, 1946)

The saturated solutions were prepared by intermittent shaking and analyzed by colorimetric comparison with standard solutions.

pH of Solution	Mols. Aloe-Emodin per liter
9.8	0.00076
10.0	0.000963
10.4	0.00148
10.8	0.00287
11.0	0.00433

By means of the apparent ionization constant it was found that the intrinsic solubility of Aloe-Emodin is 5.5×10^{-5} mole per liter.

DYES

SOLUBILIZATION OF DIMETHYL AMINOAZO BENZENE (DMAB) AND OF 1-o TOLYLAZO-2-NAPHTHOL (Orange OT) IN AQUEOUS SOLUTIONS OF SODIUM AND POTASSIUM LAURATE SOLUTIONS AT 30°
(Kolthoff and Stricks, 1948)

An excess of the dye was added to solutions of varying concentrations of the Soap (Na and K Laurates) and the mixtures rotated at 30° for 1 to 2 weeks. The bottles were placed in an upright position to allow the excess of dye to settle. The supernatant dye solution was filtered through a plug of glass wool and a measured amount diluted in a volumetric flask with Ethanol. The extinction given by the dissolved dye was measured in 1 cc cells in the Beckman Spectro Photometer and the concentration determined by comparison with calibration curves made with the pure dye.

Results of the Solubilization of:

DMAB			Orange OT		
Moles Soap per liter	Mgs. DMAB per liter in:		Moles Soap per liter	Mgs. Orange OT per liter in:	
	Na Laurate	K Laurate		Na Laurate	K Laurate
0.0059	1.05	-	0.0059	0.682	2.20
0.0118	2.54	1.19	0.0118	0.815	2.62
0.0235	3.30	1.49	0.0235	3.02	3.02
0.0469	33.1	31.8	0.0468	27.25	31.5
0.0938	108.	105.	0.0938	88.0	91.9
0.1875	242.	249.	0.1875	212.7	216.5
0.375	509.	498.	0.375	-	462.0
0.75	-	981	0.749	-	945.0

Similar results are given for 50° and for concentrations of 0 - 0.16 mols. soap per liter at the two temperatures.

The authors also give a very extensive series of determinations of the solubilization of DMAB in Na and K Caprates, Oleates, Stearates, Palmitates, Myristates, Dodecyl Amine HCl, Di sec. Butyl Naphthalene Sulfonate, Daxad 11, Triton R-100, Aerosol AY, K Dehydro Abietate and Na Rosinate.

DYES (Con.)

SOLUBILITIES OF YELLOW AB AND ORANGE OT IN 1.0 PERCENT AQUEOUS SOLUTIONS OF SOLUBILIZERS AT 25°

(Merrill, Jr. and McBain, 1942)

Solubilizer	Mgs. Dye per 100 cc Solution		Solubilizer	Mgs. Dye per 100 cc Solution	
	Yellow AB	Orange OT		Yellow AB	Orange OT
Duponal	20.8	8.0	Aquasol AR	62.0	10.0
Aerosol OT	12.0	1.61	Monosulph	75.0	18.6
Lauryl Pyridinium Iodide	31.9	12.4	Morpeltex B	36.8	3.80
Sodium Novenate	3.1	4.6	Na Deoxycholate	6.1	1.52
Sapamine MS	53.5	8.5	Na Taurocholate	5.6	1.45
Anhydrous Wettal	60.2	10.4	Na Cholate	2.4	0.29
			Na Dehydro Cholate	0.0	0.0

Results are also given for the solubility of Orange OT in 0.01 N solutions of pure colloidal electrolytes at 25°.

SOLUBILITY OF ORANGE OT IN AQUEOUS SOLUTIONS OF AEROSOL T AT 25°

(Merrill, Jr. and McBain, 1942)

Normality of Aerosol T	Mgs. Orange OT per 100 cc Sol.	Normality of Aerosol T	Mgs. Orange OT per 100 cc Sol.
0.0010	0.02	0.0125	0.64
0.0020	0.04	0.0150	0.88
0.0037	0.07	0.0200	1.25
0.0050	0.14	0.0225	1.55
0.0075	0.31	0.0250	1.82
0.0100	0.47	0.0300	2.32 - 2.48

Results for the solubilization of Orange OT in aqueous solutions of K Laurate, K Caprylate, K Caprate and K Myristate alone and with added inorganic salts. In general the results are expressed in terms of gm. of dye per mole of soap. (McBain and Green, 1946).

Results for the solubilization of Orange OT in aqueous solutions of Hexanoline Oleate, Catol 607, Nonethylene Glycol Monolaurate, Detergent X and Triton NE at 0°, 25° and 70°, with, in some cases, added KCl, are given by McBain, Wilder, and Merrill, Jr., 1948. Results are also given for the solubilization of Orange OT and Yellow AB in aqueous 0.1 normal solutions of Na Deoxycholate, Na Cholate, Na Dehydro Cholate and Oronite Sulfonate.

OILS

The solubility of Cotton Seed Oil in aqueous solutions containing from 0 to 40 percent of Sodium Benzene Sulfonate, Sodium p Cymene Sulfonate, Sodium Toluene Sulfonate and Sodium Xylene Sulfonate, was found to be less than 0.05 gm. per 100 cc aqueous solvent at 25° and at 60°. (Booth and Everson, 1949).

PARAFFIN WAX, PARAFFINIC OIL, NAPHTHENIC OIL

THE CRITICAL SOLUTION TEMPERATURES OF MIXTURES OF PARAFFIN WAX (PW), PARAFFINIC OIL (PO) AND NAPHTHENIC OIL (NO), EACH SEPARATELY, WITH VARIOUS SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture			Solvent	C.S.T. of the Mixture		
	PW	PO	NO		PW	PO	NO
Acetic Acid	178	201	153	o Phenetidine	80	35	46
Acetic Anhydride	160	172	143	p Phenetidine	139	131	90
Propionic Acid	8	10	-31	Ethyl Formate	65	71	41
Chloro Acetic Acid	238	220	187	Ethyl Acetate	12	10.5	-17
Furoic Acid	267	250	214	Ethyl Aceto Acetate	125	130	101
Benzoic Anhydride	123	124	66	Ethyl Lactate	115	121	94
Phthalic Anhydride	215	209	160	Ethyl Oxalate	114	120	85
Anthranilic Acid	229	227	175	Butyl Oxalate	23	14	-22
Methanol	187	204	188	Methyl Fuorate	114	113	78
Ethanol	112	128	108	Ethyl Fuorate	85	85	49
n Propanol	65	82	48	n Propyl Fuorate	53	49	12
Isopropanol	68	83	60	n Butyl Fuorate	57	58	15
n Butanol	25	36	1	n Amyl Fuorate	51	50	9
Isobutanol	38	50	28	Methyl Anthranilate	101	99	55
sec.-Butanol	18	31	9	Phenyl Phthalate	190	-	-
Isoamyl Alcohol	12	18	-15	Ammonia	-	-	-
Diacetone Alcohol	94	96	65	Carbon Dioxide	-	-	-
Methyl Cellosolve	115	119	95	Sulfur Dioxide	95	113	86
Cellosolve	98	106	74	Acetone	65	77	52
Methyl Carbitol	192	200	168	Acetophenone	51	47	13
Carbitol	125	133	109	Quinone	162	152	117
Ethylene Chlorohydrin	170	171	141	Nitro Benzene	54	53	14
Furfuryl Alcohol	180	183	148	o Nitro Toluene	39	35	-4
Tetrahydro Furfuryl Alcohol	150	150	115	o Nitro Phenol	81	76	32
Benzyl Alcohol	123	119	76	o Nitro Chloro Benzene	78	73	28
Phenyl Ethanol	99	98	47	p Nitro Benzyl Chloride	139	134	80
Cinnamyl Alcohol	152	152	145	2-Nitro-4-Methyl Phenol	56	54	12
Croton Aldehyde	63	69	32	m Dinitro Benzene	238	230	169
Dicroton	35	27	-8	2, 4-Dinitro Chloro Benzene	218	206	151
Aldol	116	122	86	Phenol	117	112	74
Paraldehyde	34	40	12	o Cresol	82	76	28
Furfural	159	165	122	m Cresol	94	93	43
Benzaldehyde	49	45	14	p Cresol	97	98	48
Salicyl Aldehyde	80	78	39	Cresylic Acid	74	74	23
Aniline	116	115	75	o Chloro Phenol	58	50	6
o Toluidine	72	69	34	p Chloro Phenol	111	103	55
p Toluidine	63	54	-	2, 4-Xylen-1-ol	21	27	(-30)
Xylidines	34	29	-14	o Benzyl Phenol	116	108	54
Methyl Aniline	-	46	-	Eugenol	64	63	21
α Naphthylamine	145	141	87	o Hydroxy Diphenyl	77	69	18
β Naphthylamine	160	155	98	m Hydroxy Diphenyl	162	156	100
o Amino Diphenyl	88	82	28	β Naphthol	159	152	92
p Amino Diphenyl	155	142	93	Acetanilide	233	232	176
Diphenyl Amine	67	64	10	n Butyramide	-	-	>231
Diphenyl Ethylene Diamine	139	134	85	Chlorex	70	68	34
Phenyl α Naphthyl Amine	90	70	24	Dioxane	45	45	14
o Chloro Aniline	50	46	6	α Naphthonitrile	92	91	42
o Nitro Aniline	227	216	163	β Naphthonitrile	98	95	43
3, 4-Nitro Amino Toluene	191	187	129	Pyridine	23	25	-10
				Thiocarbanilide	179	177	153

WAX

The solubility of Cotton Wax at temperatures from 0° to 70° in ten solvents (Benzene, Toluene, Xylene, Turpentine, Carbon Tetra Chloride, Carbon Disulfide, Chloroform and Skellysolvent) in which it is readily soluble (about 10 - 15% at 25°) and ten solvents (Methyl Alcohol, Ethyl Alcohol, n Propyl Alcohol, n Butyl Alcohol, Isoamyl Alcohol, tert. Butyl Alcohol, Diethyl Ether, Ethyl Acetate, Acetone and Glacial Acetic Acid) in which it is difficultly soluble (about 2 - 4% at 25°), is reported in the form of diagrams by Tonn and Schoch, 1946.

COAL TAR

Data for the two-phase system formed with soluble Coal Tar, Pentane and Liquid Propane at 30°, 60°, 80° and 90° are used by Kulin, Jr., 1940 to demonstrate the use of selective solvent action in the separation of complex mixtures.

LIGNIN

Data for the solubility of Lignin in Methanol and for the ternary equilibrium in the system Methanol, Methanol-Soluble Lignin and Insoluble Lignin Cellulose, as well as the application of this data to the counter current extraction of acid hydrolyzed Ligno Cellulose, are presented by Katzen, Sawyer, and Othmer, 1945.

ACETYLATED WOOD

Resin free, alkali extracted red oak wood meal, was acetylated with Acetic Anhydride, using sulfuric acid as catalyst. The "crude acetylated wood" was recovered by pouring the reaction mixture into water.

The solubility of this crude acetylated wood in Chloroform varied with the maximum temperature of acetylation as follows.

Maximum Temperature of Acetylation	Average Solubility in Percent
25	47.7
28	73.3
35	78.4

This indicates that the extent of acetolysis determines the degree of solubility of the crude acetylated wood in organic solvents. (Peniston, McCarthy, and Hibbert, 1940).

CELLULOSE

The approximate solubility of Cellulose (Cotton Linters) in mixtures of liquid Nitrogen Tetroxide (N_2O_4) and some 60 organic compounds which are miscible with or soluble in this oxide of nitrogen, varies from 0.1 to 0.5 gm. Cellulose per 10 cc of solvent at room temperature. The content of N_2O_4 in the mixed solvents varied from 50 to 90 wt. percent. (Fowler, Jr. Unruh, McGee, and Kenyon, 1947).

CELLULOSE ACETATES

Results, for the most part, in the form of diagrams, are given by Papkov and Korschunova, 1938, for the solubility of Cellulose Acetate with the higher acetyl numbers, in mixtures of solvents. The outmost point of these curves is the critical temperature. From changes in the position of these points the dissolving capacity of the components of the solvent mixture is deduced.

See also under Polymers

Approximate estimates of the solubility of six commercial Cellulose Acetate Butyrate Esters in single solvents, binary mixtures and complex lacquer type solvent mixtures, are given by Malm and Smith, Jr., 1949.

SOLUBILITY OF CELLULOSE TRIACETATE IN SEVERAL SOLVENTS

(Marvel, Harkema, and Copley, 1941)

Solvent	Formula	Gms. $C_6H_7O_2(OOCCH_3)_3$ per 100 gms. Solvent
Phenyl Acetylene	$C_6H_5C{:}CH$	0.018
Thiophenol	C_6H_5SH	0.032
1-Heptyne	$CH_3(CH_2)_4C{:}CH$	0.010
Nitro Methane	CH_3NO_2	0.017
Methyl Ethynyl Carbinol	$(CH_3)_2OHCC{:}CH$	5.4
Pyrrol	$NHCH{:}CHCH{:}CH$	13.0

CELLULOSE NITRATE

SOLUBILITY OF CELLULOSE NITRATES CONTAINING VARYING PERCENTAGES OF NITROGEN, IN SEVERAL SOLVENTS AT 20° (?)

(Wadano, 1940)

Percent N in Cellulose Nitrate	Gms. Cellulose Nitrate per 100 gms. Saturated Solution in: Methanol	Ethanol	95.5% Ethanol	10% Camphor in Ethanol	20% Camphor in Isobutanol
7.66	2.3	0.8	0.2	0.8	-
8.36	3.2	0.8	0.6	1.5	-
9.03	19.5	5.8	5.5	14.6	-
9.95	84.6	31.1	32.8	71.0	-
10.28	100.	71.0	58.0	94.0	0
10.87	-	100.0	30.7	100.0	-
11.22	-	82.0	10.0	100.0	5.3
11.72	-	13.9	1.5	-	-
12.27	100.	2.9	0.8	7.3	2.0
12.72	6.7	1.4	0.6	2.2	-
13.21	2.0	1.0	0.6	1.0	-

Percent N in Cellulose Nitrate	Gms. Cellulose Nitrate per 100 gms. Saturated Solution in: Methyl Acetate	Ethyl Acetate	Butyl Acetate	Acetone	Methyl Ethyl Ketone
7.66	6.0	2.5	2.2	3.8	4.0
8.36	34.0	6.0	3.3	7.4	-
9.03	95.6	63.8	32.8	72.0	68.0
9.95	100.	100.	100.	100.	95.5
10.28	-	-	-	-	100.0
13.21	67.2	-	-	-	-

Results are also given for the solubility of Cellulose Nitrates containing varying percentages of Nitrogen, in mixtures of Acetone + Benzene, Camphor + Alcohol and Ether + Alcohol.

POLYMERS

SOLUBILITY OF SEVERAL POLYMERS IN CHLORINATED SOLVENTS AT 30°

(Marvel, Dietz, and Copley, 1940)

Polymer	Gms. Polymer per 100 gms. Solvent in: $CHCl_3$	CCl_4	$CHCl{:}CCl_2$	$Cl_2C{:}CCl_2$	$CHCl_2CHCl_2$
Ethylene Phthalate	> 100	0.021	1.0	0.007	33
Superpoly Hexamethylene Adipate	> 87	10.0	55.0	0.06	77
Superpoly Ethylene Adipate	>100	0.114	> 85.0	0.078	> 100
Polymethyl Methacrylate	77	0.116	96.	0.047	> 100
Cellulose Acetate	5.2	0.002	0.002	0.001	5.8
Polyvinyl Acetate	> 100.	9.3	64.0	0.003	> 100.
Polymethyl Vinyl Ketone	> 100	0.002	78.0	0.001	70

The solubilities marked with a > are at 25° and are probably minimum values.

SOLUBILITY OF SEVERAL POLYMERS IN HYDROGEN BONDING SOLVENTS AT 30°

(Marvel, Harkema, and Copley, 1941)

Polymer	Gms. Polymer per 100 gms. Solvent in: (A)	(B)	(C)	(D)	(E)	(F)	(G)
Polyvinyl Acetate	93	85	109	93	71	53	81
Polymethyl Vinyl Ketone	40	24	0.036	35	19	< 0.2	25
Polymethyl Methacrylate	46	33	0.73	19	27	< 0.3	41
Polyvinyl Chloride	0.085	0.048	0.106	0.004	0.007	-	0.115
"Vinylite" (34.1%Cl)	110.	99	0.053	2.1	0.504	-	86.

A = Phenyl Acetylene $C_6H_5C{:}CH$

B = Thiophenol C_6H_5SH

C = 1-Heptyne $CH_3(CH_2)_4C{:}CH$

D = Nitro Methane CH_3NO_2

E = Methyl Ethynyl Carbinol $(CH_2)_2OHC{\cdot}C{:}CH$

F = n Methyl Acetamide $CH_3CONH(CH_3)$

G = Pyrrol $NHCH{:}CHCH{:}CH$

POLYSTYRENE

Results for the solubility of Polystyrenes of high molecular weight (Est. 250,000) in n alkanes and mixtures with Toluene at temperatures up to 260° are given by Power, 1949a. The solubilities were found to be noticeably less than for the samples of lower molecular weight previously studied. (See, under Styrene, C_8H_8, p 700). In the case of the higher molecular weight samples, the critical resin concentration occurs well above 50%, but for the samples of low molecular weight it may exceed 90%. This, however, may be reversed depending upon whether a good or poor solvent is used in the one case or the other.

POLYTHENE

Data for the solubility of Polythene in organic liquids of different type, and for the amounts of these liquids absorbed by solid Polythene, are given by Richards, 1946. Hydrocarbons and Halogenated Hydrocarbons are the best solvents and are absorbed to the greatest extent. Diagrams as well as numerical results are given for the solubility of Polythene in, and its absorption by, Nitro Benzene, Amyl Acetate, Xylene, n Heptane, n Cetane, Paraffin Wax, etc.

SAPONIN (Sapoalbin)

SOLUBILITY OF SAPONIN IN AQUEOUS ETHYL ALCOHOL AT ABOUT 20°
(Verstraete, 1948)

A series of sealed tubes were prepared to contain increasing excess of Saponin suspended in 5 cc volumes of aqueous alcohol of increasing alcohol content. The tubes were mechanically shaken for 15 hours and the dissolved Saponin found by residue determination. (It is not specified whether undissolved residue of Saponin or residue obtained by evaporation of saturated solution is intended)

Solid Phase in percent	Saponin dissolved in Aqueous Alcohol of:						
	0%	20%	35%	50%	65%	80%	96%
1.75	1.75	1.75	1.70	1.75	1.73	-	0.00
4.36	4.36	4.30	3.20	4.26	3.98	2.78	0.00
8.75	8.75	8.20	5.96	7.97	5.56	3.50	0.01
13.08	13.08	11.87	6.16	10.21	6.36	4.38	0.00
17.50	17.50	15.71	3.20	11.30	7.68	-	0.06
21.88	21.88	19.00	4.40	12.43	8.79	-	0.08
26.25	26.25	22.30	4.88	12.26	8.79	4.75	0.14
30.63	30.63	23.27	-	12.47	8.86	-	0.12
35.00	35.00	30.85	6.40	14.84	13.37	4.75	0.13

Qualitative results are given for the solubility of Saponin in a number of other solvents.

INSULIN

The solubility of Crystalline Zinc Insulin (0.33 to 0.65% Zn) in water at 5° is of the order of 0.01 gm. per liter. The solubility in the phosphate systems in which the crystals were formed, passed through a minimum (0.05 gm. per liter) near pH 5.5 and was lower at lower ionic strengths. (Cohn, Ferry, Livingood, and Blanchard, 1941).

PENICILLIN G (Benzyl Penicillin)

SOLUBILITY OF THE SODIUM, POTASSIUM AND AMMONIUM SALTS OF BENZYL PENICILLIN IN PURE ACETONE AND IN ACETONE CONTAINING 2% OF WATER

(Page and Waller, 1949)

Results for:

t°	Sodium Penicillin: Gms. per 100 cc of Acetone Containing:		Potassium Penicillin: Gms. per 100 cc of Acetone Containing:		Ammonium Penicillin: Gms. per 100 cc of Acetone Containing:	
	> 0.5% H_2O	2.0% H_2O	> 0.5% H_2O	2.0% H_2O	> 0.5% H_2O	2.0% H_2O
-78	0.015	1.6	0.015	0.055	0.45	0.25
-40	0.011	2.6	0.004	0.070	0.33	0.15
-20	0.006	1.2	0.004	0.075	0.27	0.15
0	0.004	0.1	0.004	0.085	0.35	0.20
+25	0.004	0.1	0.004	0.090	1.2	0.35
40	0.008	0.1	0.010	0.085	1.8	0.90

Results are also given for Acetone containing 1.0% H_2O.

RIBOFLAVIN

SOLUBILITY OF RIBOFLAVIN IN AQUEOUS SOLUTIONS OF NICOTAMIDE AT ABOUT 25°

(Frost, 1947)

Supersaturated solutions of Riboflavin in Nicotamide solutions, adjusted to pH 5.0 with HCl, were made by heating. On cooling to room temperature the Riboflavin crystallized out. The concentration of Riboflavin remaining in solution was determined fluorometrically. Certain lots of Riboflavin appeared to be 5 - 10% less soluble than other lots.

Gms. per 100 gms. Solution: Nicotamide	Riboflavin	Gms. per 100 gms. Solution: Nicotamide	Riboflavin
0.0	0.011	30.0	1.0
5.0	0.10	40.0	1.6
10.0	0.24	50.0	2.5
20.0	0.56		

Results in the form of a diagram are given for the solubility of Riboflavin in 20% solution of Nicotamide acidified with varying amounts of HCl, with measurements of the pH of each saturated solution. The acidity has little effect until the pH is lowered to about 5.0. Thereafter, the solubility decreases rapidly until at pH 3.0 it is only about 0.2%.

SOLUBILITY OF PURIFIED PROLACTIN HYDROCHLORIDE IN METHANOL AND IN ETHANOL AT pH 3.1 AND 24° - 25°

(Fleischer, 1943)

Mixtures of 50 milligrams of Prolactin Hydrochloride and 0.4 cc of solvent were stirred with a glass rod during 4 hours and then centrifuged for 30 minutes at 2000 R.P.M. The clear supernatant liquid was weighed, brought to dryness in a vacuum desiccator over $CaCl_2$, and the dry weight determined. Saturation was reached with certainty in only three of the experiments.

Solvent	Source of Prolactin	Solubility of Prolactin in percent by weight
Methanol 99.5%	Sheep	21.9
Methanol 99.5%	Beef	> 14.3
Ethanol 100%	Sheep	3.5
Ethanol 100%	Beef	4.4
Ethanol 95%	Beef	> 12.9
Ethanol 95% Saturated with NaCl	Beef	> 13.2

PROGESTERONE

The average solubility of Synthetic Alpha Progesterone ($C_{21}H_{30}O_2$) in water, determined spectrophotometrically, is 0.00168 gm. per 100 cc at 25°. The solubility in aqueous saline solution (0.9% NaCl) is 0.00151 gm. per 100 cc at 25°. (Haskins, Jr., 1949).

SOLUBILITY OF PROGESTERONE IN AQUEOUS SALT SOLUTIONS, IN AQUEOUS BOVINE ALBUMINE AND IN RABBIT SERUM

(Bichoff and Pilhorn, 1948)

Note - Saturation was approached both from above and below. Variable ratios of excess solid phase to solvent, as well as renewal of the solvent in contact with the same solid phase, were employed. The dissolved Progesterone was determined by the color reaction of Zimmerman using a Lumitron colorimeter with voltage stabilizer, for photo colorimetry.

The results are given in terms of Mols. Progesterone dissolved per liter x 10^4. In each case they show the range of values obtained by variations in manner of attaining equilibrium.

Results for Aqueous Solutions of:

Salts

Gms. per 100 cc	Progesterone Dissolved at: 37.5°	59.5°
0.0 (=H_2O)	3.5 - 4.6	6.1 - 6.3
1.0 gm. NaCl	3.0 - 4.2	5.1
2.0 " "	2.3 - 3.5	4.8 - 4.9
4.0 " "	2.0 - 3.1	3.3 - 4.1
0.1 " $NaHCO_3$	3.3 - 3.7	-
2.0 " Na_2SO_4	2.8 - 2.9	-
4.0 " "	2.2 - 2.3	-

Bovine Albumin and Rabbit Serum

Gms. per 100 cc	pH	Progesterone Dissolved at: 37.5°	25.0°
1.0% Bovine Albumin	5.3	1.3 - 1.5	-
3.0% " "	5.3	2.7 - 3.4	1.9 - 2.6
3.0% " "	7.4	3.8 - 4.4	2.9 - 3.0
3.0% " "	8.1	6.2 - 6.8	-
Rabbit Serum			
6.1% Protein Content	8.5	10.9 - 12.5	-
6.2% " "	8.3	11.8	-
5.8% " "	8.2	9.5	-
6.6% " "	8.2	14.1	-

TESTOSTERONE

SOLUBILITY OF TESTOSTERONE IN AQUEOUS SALT SOLUTIONS, IN AQUEOUS BOVINE ALBUMIN AND IN RABBIT SERUM

(Bischoff and Pilhorn, 1948)

See note under Progesterone.

Results for Aqueous Solutions of:

Salts			Bovine Albumin and Rabbit Serum			
Gms. per 100 cc	Testosterone Dissolved at: 25°	37.5°	Gms. per 100 cc	pH	Testosterone Dissolved at: 25°	37.5°
0.0 (= H_2O)	0.91 - 0.99	1.24-1.30	1% Albumin	5.4	-	4.9-5.4
1.0 gm. NaCl	0.74 - 0.84	1.07-1.17	3% "	5.3	9.0-10.7	10.9-11.9
2.0 " "	0.67-0.76	0.98-1.09	3% "	7.4	12.3-12.6	13.2-14.2
4.0 " "	0.54-0.63	0.78-1.00	3% "	8.0	-	15.3-15.6
0.1 " $NaHCO_3$	-	1.21-1.23	Rabbit Serum			
2.0 " Na_2SO_4	-	0.88-0.92	5.8% Protein Content	8.2	-	28.0
4.0 " "	-	0.66-0.76	6.0% " "	8.3	-	33.0
			7.3% " "	8.5		31. - 35.

ESTRADIOL

The solubility of α-Estradiol in 1 percent Isotonic γ Globulin Solution at pH 7.0 was 3.9×10^{-5} mole per liter. At pH 5.3 to 5.5 the solubility of Estradiol in Isotonic Solution containing 3.0 gms. per 100 cc of bovine crystalline albumin is 2.0×10^{-4} per liter. (Bischoff and Pilhorn, 1948).

ZEIN (Protein from Corn)

The qualitative solubility characteristics of Zein are described in considerable detail by Swallen, 1941. It is pointed out that the general type of solubility behavior of Zein is the same as for other high-molecular-weight or colloidal materials such as Cellulose Nitrate, Acetate or highly polymerized resins.

For the purpose of finding a good binary solvent for Zein, Manley and Evans, 1943, present solubility curves showing the "Critical Peptization Temperature" (that is, the temperature above which the protein is soluble in all proportions and below which it is soluble only to the extent of 2 to 3 percent) for a long series of organic solvents, mixed with either Water, Methyl Alcohol, Ethyl Alcohol or Isopropyl Alcohol as the second component of the solvent mixture.

Results in the form of triangular diagrams are given by Evans and Manley, 1944, for a long series of ternary systems, each containing Water, and either Methyl, Ethyl or Isopropyl Alcohol as the second component and one of the following compounds, as the third component: Formaldehyde, Acetaldehyde, Butyraldehyde, Dioxane, Nitro Methane, Nitro Ethane, Acetone, Acetonyl Acetone, Diacetone Alcohol, Methyl Acetate, Methyl Cellosolve, and Benzene. In addition, diagrams of two systems without water, namely, Rosin + Ethyl Alcohol + Acetone and Toluene + Ethyl Alcohol + Methyl Cellosolve, are given.

PEPSIN (Crystalline)

The apparent isoelectric solubility of Crystalline Pepsin in aqueous 0.002 molar Hydrochloric Acid Solutions to which various concentrations of KCl, over a range of combined ionic strength of from 0.002 to 0.10, were added, are reported by Steinhardt, 1939. It was found that the solubility of Swine Pepsin, even after repeated recrystallizations was determined in part by the ratio of saturating body to solvent volume. When successive equal portions of solvent are used with a given quantity of Pepsin, the amount dissolved in each is a constant fraction of the amount dissolved in the preceding portions, until both results and solubility have been reduced to small fractions of their initial value.

HEXA ETHYL BENZENE $C_6(C_2H_5)_6$

CRITICAL SOLUTION TEMPERATURE OF MIXTURES OF HEXA ETHYL BENZENE AND OTHER SOLVENTS

(Francis, 1944)

Solvent	C.S.T. of the Mixture	Solvent	C.S.T. of the Mixture
Diethylene Glycol	258	Ethylene Diformate	159
Triethylene Glycol	235	Salicyl Alcohol	154
p Nitro Aniline	221	Maleic Anhydride	176
o Nitro Benzoic Acid	211	Catechol	119

TERNARY SYSTEMS SEPARATING INTO TWO LIQUID LAYERS

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PREFACE

This section of the Supplementary Volume of Solubilities is intended to meet the apparent need for a comprehensive compilation of the published systems of this class. These systems are the fundamentals of the growing science and art of solvent extraction. Volume II of the 1941 edition of Solubilities recorded many of these systems in tabular form; but as in all sections of the book, there have been extensive additions to the literature in the last decade.

Ternary systems are well adapted to graphical presentation on triangular diagrams. A large amount of information can thus be shown in a small space. Inaccuracies in observation often appear instantly. Different systems can be compared readily for effects of temperature change, molecular weight in a homologous series, etc. Evidence sometimes appears for association of molecules, unsuspected impurities in a reagent, etc. Moreover, a ternary diagram furnishes a rapid appraisal of the suitability of a solvent for solvent separation of the other components.

Equilateral triangles are used since any composition of three components can be represented by a point within the triangle. Its perpendicular distance to a side indicates the percentage of the component denoted at the opposite corner. Thus in Fig. 1 the corners of the triangle indicate the pure components, A, B, and C, respectively, and point P corresponds to a ternary mixture of 55% A as measured by Pa, 20% B as measured by Pb, and 25% C as measured by Pc, each in proportion to the altitude of the triangle. A point on the side of the triangle is a binary mixture so that b represents 65% A and 35% C, etc.

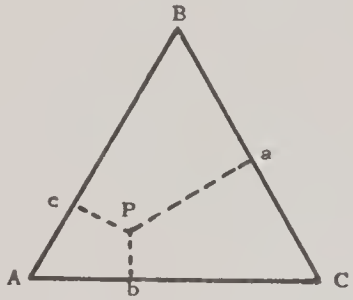


Figure 1

In the experimental study of ternary systems a fair degree of approximation suffices for many purposes since effects of small changes of temperature on liquid miscibility curves are usually slight or negligible. When accurate temperature control can be omitted, the study of ternary liquid systems is greatly facilitated. With vigorous agitation physical equilibria between liquids are reached almost instantly provided there is no chemical interaction of the reagents, and provided none of them is extremely viscous. Equilibria can be verified by the constancy of position of an interface after an additional shaking and settling, preferably in a glass stoppered graduated test tube of suitable size. Sometimes a 25 ml. buret with a glass stopper is convenient since it permits ready sampling of the lower layer for analysis. The determination of a "binodal curve", which is the curve bounding the area of compositions separating into two layers, thus merely requires several points, each obtained by titrating a known mixture of two components with the third one. The end point is the appearance or disappearance of a meniscus or turbidity ("cloud point"). During a titration the composition changes along a straight line toward one corner. This might be called an "isologous" line, from the Greek for "same ratio", since the ratio of concentrations of two components remains constant.

In order to determine the tie lines (lines connecting compositions of phases in equilibrium) one or both of the liquid layers are analyzed by titration, by refractive index or density observation, or other appropriate method, and these compositions are combined with that of the whole system. If direct analysis is impractical, indirect graphical means may be employed. Another method of analysis consists in observing the plait point (defined below) composition, and then adjusting the unknown composition of a layer in equilibrium until it reaches that of the plait point.

A majority of the published systems have a single binodal curve with both terminals on the same side of the triangle (Figs. 2-9). The consolute component, the one denoted by the opposite corner (B in most of the figures), is miscible with each of the other two components, which are not completely miscible with each other. If their mutual solubility is substantial, the curve is low and flat, often nearly the arc of a circle (Fig. 2), not a deep narrow "bite" in any real published system although often so illustrated in text books for water-phenol-aniline at three high temperatures (Fig. 3). A narrow bite would require that the critical solution temperatures (C.S.T.) of the solvent with the other two components, respectively, be within two or three degrees of each other, and that the temperature shown by the graph be between these temperatures. In such a case the bite would be sloping (Fig. 4). System aniline-1-hexene-cyclohexane at 29°C.

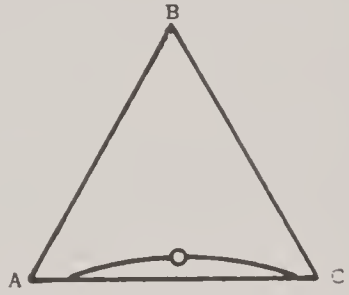


Figure 2

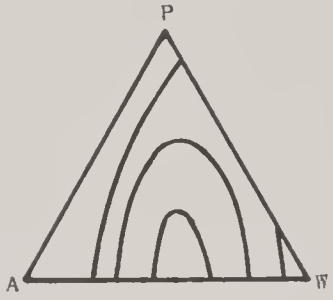


Figure 3
(erroneous)

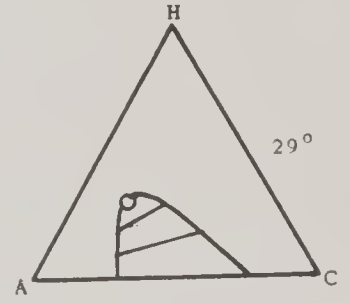


Figure 4

If the miscibility of the two components is slight, the curve is higher, usually parabolic but unsymmetrical (Fig. 5. If two components are practically immiscible, the curve is high (Fig. 6), fitting into the triangle like a hyperbola between its asymptotes.

In every such "free" binodal curve there is a "plait" or consolute point, indicated by a small circle, at which the two liquid phases approach each other in composition and properties, and the interface fades out in the middle of the system like a critical point or a critical solution point. On a low curve this point is near the mid point, but in higher curves it is practically always to one side and seldom rises above 50% of the consolute component in composition. Sometimes it is much lower. It is usually at a point of minimum curvature, not at the

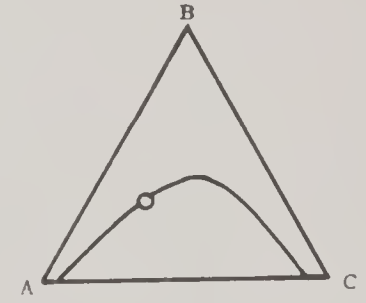


Figure 5

sharpest curvature where it might be expected. Fig. 4 is an exception. Since all of the tie lines subtend this point, its position can be used with considerable assurance to predict their orientation, which is important in consideration of the efficiency of a solvent extraction process. In fact in one paper several systems were presented on a single graph approximately by means of the plait points alone (Francis, 1950). The selectivity of the solvent is measured roughly by the distance of the plait point from the solvent corner.

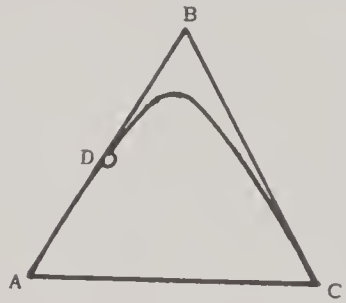


Figure 6

The shortest tie line is coincident with a tangent to the curve at the plait point. At the other extreme the longest tie line is the portion of the base line between the terminals of the binodal curve. The other tie lines usually fan out between these two and point approximately toward a single point which is on the base line extended. There are exceptions to this generality. In some systems there is a reversal in slope of the tie lines (Fig. 7). These have been called "solutropes" in a recent paper (A. S. Smith, 1950) by analogy with azeotropes. However, a nonselective tie line is not one which is horizontal, but one pointing directly toward the solvent corner (an isologous line). Solutropes are not rare. More than seventy are listed in this volume.

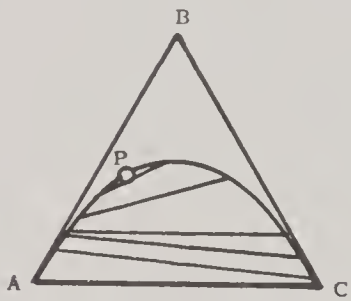


Figure 7

The literature on correlation of tie lines by means of conjugate lines and other means is voluminous. The discussion need not be repeated here except to note that conjugate lines are never quite straight, as sometimes assumed; that they always intersect the binodal curve at the plait point; and that those which are highly curved are of little help in correlation. Conjugate lines will not be used in this volume since it is considered that except on a large scale it is difficult to construct them with sufficient precision to compare with that of the tie lines themselves.

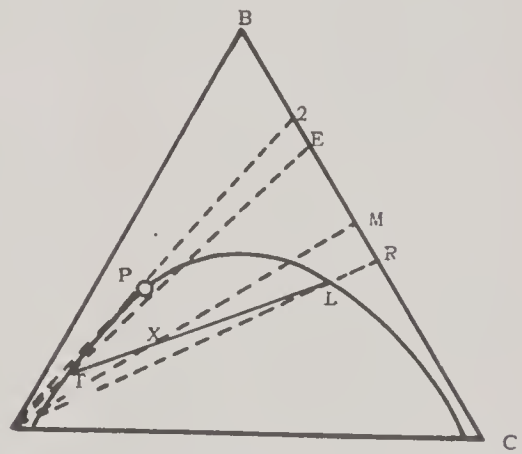
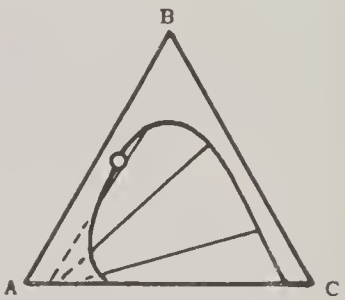


Figure 8

For solvent extraction the importance of the orientation of the tie lines is indicated in Fig. 8. To a mixture M of B and C is added solvent A, giving a composition X on tie line TL. The system stratifies into two layers T and L. These are segregated, and the solvent is

removed from each by distillation, washing, or other appropriate means. The compositions follow the isologous lines TE and LR, which point directly away from the solvent corner A, giving an extract E and a raffinate R, of compositions different from the charge M. The process could be repeated indefinitely without necessarily separating solvent from fractions between stages, giving eventually almost pure C. The purity of B to be reached by this means is limited by the height of the curve, since there would be no further enrichment beyond the other end of an isologous tangent AZ to the curve through A. It is evident that if TL were horizontal or sloped down to the right, the enrichment by solvent extraction would be much more rapid. On the other hand, if TL is an isologous line pointing directly toward corner A, as in a few systems, there would be no selectivity, and the solvent extraction would be useless.



f Figure 9

It would seem anomalous for any tie line to be so steep that its extension would intersect the base line inside the triangle, since this would mean a higher concentration of the consolute component (B) in the raffinate than in the extract. (BC mixtures after removal of solvent A from the phases on the right and left sides of the curve respectively). Although such cases have been observed experimentally (Elgin 1949, Francis 1949) they are exceptional, and occur only if the binodal curve is undercut, that is the solubility of C in certain mixtures of A and B is much less than in pure A, although it is miscible with B (Fig. 9). This probably involves solvation or packing of A and B molecules, making the mixture less pervious. The plait point in such a curve is at almost the nearest approach to the side line. If the curve is expanded by cooling the system, its contact with the side line must be at the plait point, since a portion of the side line immediately becomes a tie line. In the usual binodal curve the plait point is between the points of contact of the two isologous tangents to the curve drawn from the corners of the triangle denoting the nonconsolute components.

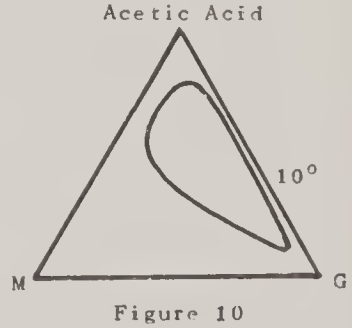


Figure 10

An extreme illustration of undercut curves is shown in Fig. 10 containing a "hole in the diagram." In these each binary system exhibits complete miscibility. Such a curve has two plait points. Examples are acetic acid with methyl- or dimethylaniline and gasoline, which are presumably due to a formation of a salt even though the latter remains in solution. In order to make the system really ternary, n-heptane can be substituted for gasoline (Francis 1950a). Some other cases are published where a "hole" appears at elevated temperatures, e.g. water with acetone and phenol. For these there is a ternary critical solution temperature (about 90.5°C in the system mentioned).

If only one pair of the three components is miscible, the binodal area is usually a band across the other two sides (Figs. 11 and 12). Having determined the four binary solubilities, one may describe the system almost completely by drawing slightly convex curves connecting points on the sides of the triangle corresponding to these solubilities. The two curves are so coordinated that they may be considered portions of the same curve including an imaginary portion (dotted line) outside the triangle. If the two miscible components B and C are very similar in solubility in A, the two binodal curves may be practically straight lines (Fig. 12). In either case most of the tie lines usually point slightly above the solvent corner, indicating some selectivity, so that with a sufficient number of stages of contact, as with counter-current extraction, substantial separation of B and C can be accomplished with solvent A. The tie line DE, which is a portion of the side line AB, is, of course, isologous and nonselective; and those near to it are very nearly so.

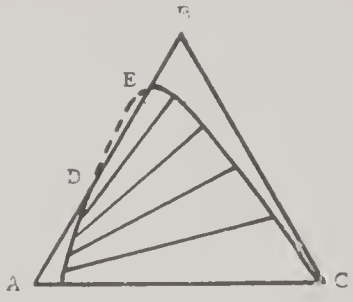


Figure 11

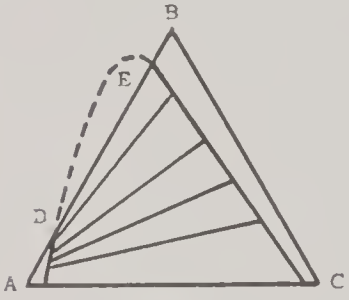


Figure 12

Figs. 2, 5, 6, 11 might apply to the same system over a wide temperature range. The choice of conditions for solvent extraction depends on the relative importance of selectivity, which is highest in Fig. 5, and purity of product, which is highest in Fig. 11. An optimum balance might correspond to Fig. 6. This results when the extraction temperature is near or slightly above the C.S.T. of the solvent (A) with the most soluble component (B).

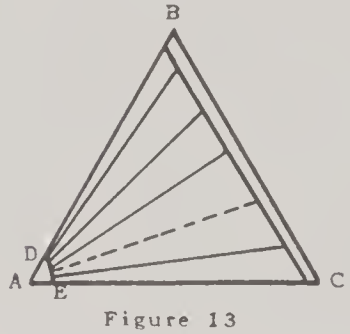


Figure 13

In most of the ternary systems investigated the binodal curves are entirely convex. Some of the few which show slight concavities have been confirmed experimentally by the compiler. However, these appear only on portions of the curves nearly perpendicular to the tie lines (DE Fig. 13) for water-furfural-ethyl acetate. It is theoretically impossible for a plait point to be on a concavity (Fig. 14, 15) in a ternary system, because the first short tie lines, TL, which subtend it, would cross the one phase area. A point on such a tie line by definition must separate into two layers; but cannot do so because it is in a one phase area. Such a concavity (or adjacent hump), which appears in a few published systems, is evidence that one of the components contains an impurity, making the system quaternary.

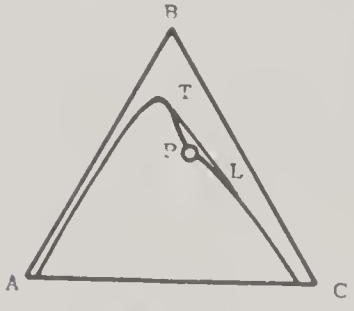


Figure 14

Thus a few percent of water in an alcohol gives a decided hump in a curve with two hydrocarbons. In aqueous systems an impurity of an olefin in an alcohol or of an ester in an acid causes a similar hump. One system, water - sulfuric acid - ethyl ether (see tables) exhibits a saddle-like graph with a concavity, in spite of pure components. This is due to a reversible formation of ester, thus providing the fourth component. There is no plait point, however. Since in almost any quaternary system the impurity is not distributed uniformly between the phases, even when the curve is not distorted, the extremities of the tie lines are not on the phase boundary curve of a plane diagram, as sometimes represented in the literature.

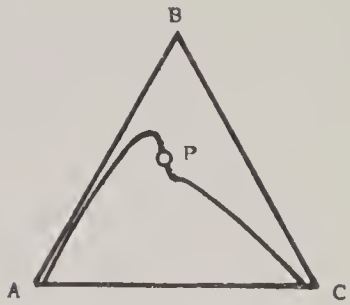


Figure 15

Triangular diagrams may become more complicated by the existence in the system of one or more solid phases or of three liquid phases, although these have so far had little application in solvent extraction.

A system with a solid phase is illustrated in Fig. 16 in which component A is a solid, D is its saturated solution in B, DT is its solubility curve in BC mixtures lean in C, and TE is the metastable continuation of this curve which would result if melted A were miscible with liquid C. Curve FTPNG is the binodal curve which would result if crystallization of A were prevented, the portion TPN being stable and the rest metastable. TN is a tie line, and NH is the solubility curve of solid A in liquids rich in C. The several areas are marked (L = liquid phase). (Systems water - ethanol - nitrophenols).

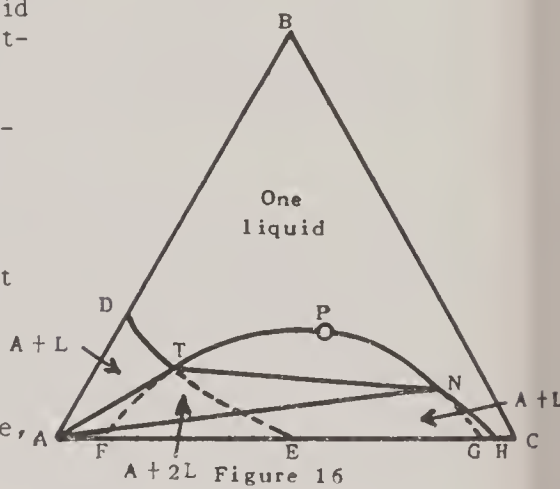


Figure 16

A system with three liquid phases is illustrated in Fig. 17, containing an internal triangle, abc. The positions of its corners indicate the compositions of the three layers, which at constant temperature are independent of the total composition of the system provided it is within the area, abc. The numbers, 1, 2, and 3, indicate the numbers of liquid phases when the compositions are in the respective areas. Each side of the smaller triangle is a tie line, as are portions of the side lines, DE, FG, and HJ. Graphs of this type illustrated in physical chemistry text books are highly distorted from those of any real or probable system. In real ones usually two of the components (A and C in the figure)

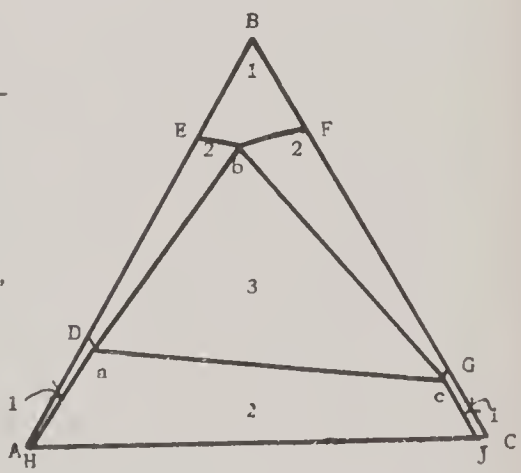


Figure 17

are practically immiscible; the six binodal curves Eb, bF, aD, aH, cG, and cJ are usually almost straight; and the two quadrilateral two-phase areas, abED and bcGF have their broader bases on the inside triangle rather than on the side lines. It is possible for one or both of these two areas to fall short of the side lines and thus be a thin loop with its own plait point (Fig. 18). (Francis, 1950). Component B would then be miscible with A or C or both.

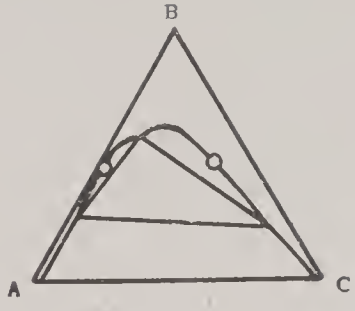


Figure 18

In any diagram with a three phase area (either solids or liquids) care should be taken that Schreinemakers' rule is observed with respect to the corners of the internal triangle. Marsh (1935) expressed it as follows: "The extensions of the one-phase region boundaries must be either (1) both within the three phase region or (2) both within the two-phase regions." Thus in Fig. 17 Ha and Jc must be directed outside the triangle into the two-phase areas, abED and bcGF, respectively, since Da and Gc are directed into the two-phase area HacJ. Similarly, in Fig. 16 since TE, the extension of DT, clearly would enter the triangle, ATN, PT must be curved enough so that its extension, TF, also enters it, and since PN extended could not possibly enter it, HN must be directed so as to extend into the loop, NPT, and not into the triangle. This rule is violated frequently in illustrative ternary diagrams, including several in Marsh's book although he emphasized the importance of the rule. Fig. 19 shows erroneous relations at all three corners.

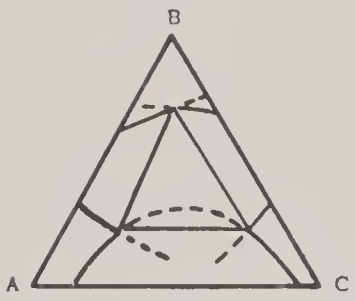


Figure 19
(erroneous)

It is suggested that even for a three-liquid phase system the six binodal curves (solid lines; Fig. 20) can be coordinated into a single curve by means of imaginary extensions (dotted lines) as in Figs. 11, 12. The whole curve would be a loop curving through about 480° as illustrated in Fig. 20. (curve HabFGcaDEbcJ).

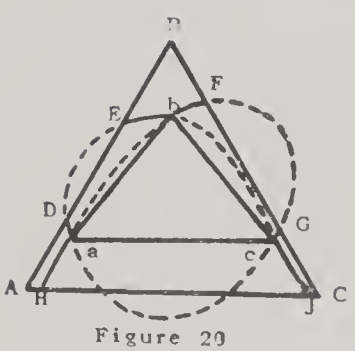


Figure 20

Systems with three liquid phases are by no means rare although real diagrams for few of them have been reported. It is possible to predict hundreds of them, for example, water with aniline or phenol and with almost any liquid nonaromatic hydrocarbon. In one paper (Vondracek and Dostal, 1936) are reported quantitative data on four of these hydrocarbons with

water and phenol, giving only the curves bF of Fig. 17 or 20. The authors failed to observe that in each case the lower nonhydrocarbon layer also stratified into two layers, or three in all. The high viscosity and closeness in density of these two layers make it require an hour or more for complete separation.

Some systems have been investigated with several solid phases and with some compositions separating into three liquid phases, for example, water-silver perchlorate-benzene or toluene (Hill and coworkers, 1922, 1925).

It is possible to have two or even three separate binodal curves on different sides of the triangle. Some physical chemistry text books have cited these as typical; but no actual system with three separate curves, and only one with two separate curves has been published. This is water - succinonitrile (ethylene cyanide) - ethanol (Fig. 21) (Schreinemakers, 1898). It seems anomalous that ethanol should increase the mutual miscibility of water and nitrile in spite of its nonmiscibility with the latter. This probably accounts for the rarity of the phenomenon. The unusual picture probably depends upon the formation of solvate molecules. A system with three separate curves would be still further anomalous since it would not be expected that the mutual solubility of the two liquids would be increased greatly by a third component not miscible with either of them; and especially that such relations would exist on all three pairs. However, it is not theoretically impossible, and several such systems have been observed experimentally in the compiler's laboratory. These will be described in a later paper.

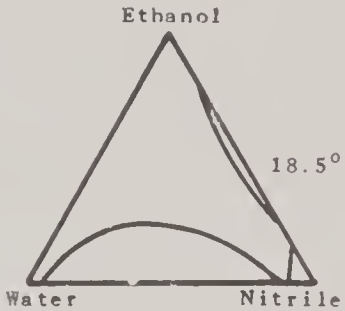


Figure 21

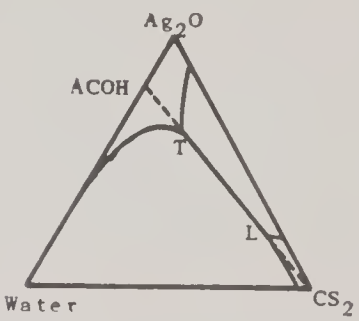


Figure 22

There has been speculation in text books as to the manner of intersection of two binodal curves if they were enlarged by cooling the system or otherwise. The system of Fig. 21 fails to give the answer since two of the components, nitrile and water, freeze before contact of the curves. It seems probable that the first contact must be at both plait points, giving a band as Fig. 22, with definite kinks in the curves. Contact at some other point of a binodal curve, Fig. 23 as suggested in some text books without experimental evidence, would have several theoretical objections (Francis, 1950, pp. 252-3).

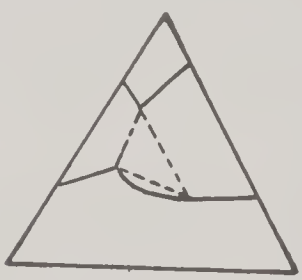


Figure 23
(erroneous)

The only published cases of real systems with intersecting binodal curves are those involving definite molecular compounds such as acetic acid in a system, water - acetic anhydride - carbon disulfide (Mochalov, 1937) (Fig. 22) or gasoline (Mertslin, 1937). Such a system is really quaternary, and the diagram might be considered as two adjacent ternary diagrams each with a band similar to that of Fig. 11. The tie line of intersection, TL in Fig. 22, points exactly toward the CS_2 corner (isologous line) and toward the binary composition of water and acetic anhydride corresponding to acetic acid (15% water). Actually the graph represents only quasi-equilibrium since the acetic anhydride is only partly hydrated. With no hydration the system would have three layers; and with complete hydration the curves would be separate, since acetic acid mixes with either carbon disulfide or gasoline as well as with water.

Ternary systems with graphs containing intersecting binodal curves showing true equilibria have been found in the compiler's laboratory, even though no intermolecular compound was possible. The common tie line still seems to be isologous, though perhaps not rigorously so.

Sometimes the densities of two liquid phases in equilibrium are identical so that they do not stratify on standing, but remain as long lasting emulsions, sometimes as beautiful mosaics of large intermingled globules, or separate into large shapeless masses, depending upon the interfacial surface tension. Such a phenomenon is inevitable in a system like those in Figs. 11 and 12 if the density of component A is between those of B and C. It would usually occur also with Fig. 6 under the same conditions, and is possible with a lower curve as in Fig. 5 or even Fig. 2. A tie line connecting compositions of phases of equal density is called an "isopycnic" from the Greek for "same density". In about fifty of the figures in this section an isopycnic is indicated by a straight dashed line across the binodal curve even though its exact position may be uncertain (Fig. 13).

The compiler has prepared an isopycnic for demonstration purposes with water - methanol - benzene. The aqueous layer is colored bright blue with a trace of copper ammonium nitrate, and the benzene layer is colored bright red with a trace of an azo dye. The gradual resolution of the phases caused by surface tension makes it an interesting toy.

Isopycnics may appear also in plots of binary systems with a temperature axis, such as with aniline and water (Fig. 24). These are less common because it is unusual for the heavier liquid at low temperature to expand sufficiently more rapidly with temperature than the lighter one so as to reverse the relative densities. Upper and lower layers are indicated by U and L respectively.

Isopycnics have no theoretical significance with respect to solubility. One author noted a maximum mutual solubility at the temperature of the isopycnic, but this must have been coincidental. Isopycnics have practical

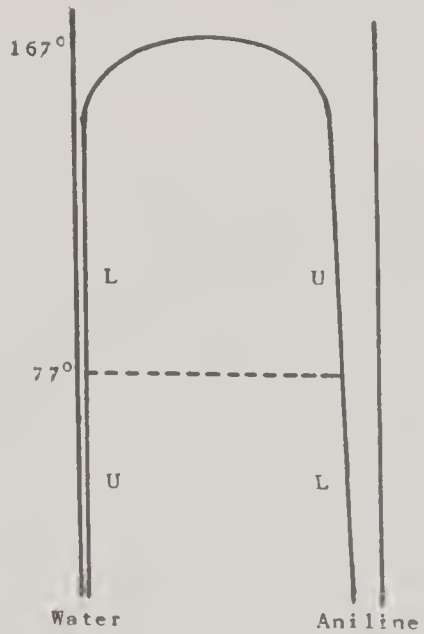


Figure 24

importance, however, since they hinder solvent extraction, and thus may disqualify some otherwise suitable solvents or conditions. On the other hand they should have value in studying some surface tension phenomena. For example it should be possible to demonstrate variations of solubility with size of droplets as a result of surface tension. A reversal of the internal and external phases in an emulsion near the isopycnic may be possible.

An analogous coincidence, an "isooptic",occurs when the refractive indices of two liquid phases in equilibrium are equal. This may be a nuisance in experimental work when it renders observation of the interface between the layers difficult. Observation may be aided by a trace of dye or of an insoluble powder which floats at the interface. Mondain-Monval and Quiquarez (1940, 1944) studied the phenomenon in several papers, but overlooked the beautiful structural colors exhibited by such systems under certain conditions. Isooptics are probably as common as isopycnics in the liquid systems, but they are not shown on the graphs of this section because of their lower practical importance, the inadequacy of data, and the fact that they are lines only for monochromatic light.

In compiling ternary data and in studying experimental work it has been found convenient to use as a drawing tool a transparent plastic sheet curve as shown in Fig. 25. It permits quickly drawing accurate triangles and any of five binodal curves, numbered in order of height, which can be fitted into the triangles. Intermediate curves can be drawn in portions by adjusting one or more of the other curves, as with a French curve. Pencil and ball point pen are very suitable. A ruling pen also may be used for the curves although the sharpness of curve 5 requires caution. It is unsatisfactory for drawing the triangle because contact at the corners frequently causes blots. Triangles are best made with a pencil and then inked with a straight edge. However, shorter tie lines can be ruled with a portion of a side of the triangle. The holes are for marking plait points, the smaller one for pencil and the larger for ball point pen.

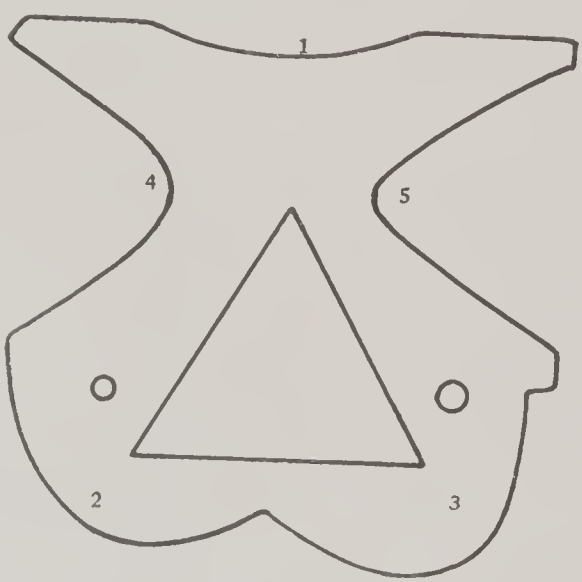


Figure 25

Description of Tables and Graphs.

A ternary system listed in the 1941 edition is illustrated by a triangular graph with citation to the page in that volume and also to other references not cited there; but numerical data listed there are not repeated. Systems not previously listed are illustrated, accompanied by selected numerical data. These data are fairly complete for the journals not readily available to American chemists. For systems from the commoner journals only enough points to plot the graphs are included. Preference is given to the coordinates for tie lines when available, since these determine also the position of the binodal curve.

For uniformity weight percentages are plotted in all of the graphs. This required recalculation for some systems in which the results are reported in mole percentages, a method of little significance unless solid intermolecular complexes are formed. Leikola (1940) gave only the weights of reagents used in titration for 66 systems. The fifty systems studied by Bonner (1910), reported in weight percentages with one pair totalling 100%, also required recalculation, as did a few systems with data and plots of volume percentages. The latter are not quite satisfactory for ternary diagrams because in such nonideal solutions "volume percentages" is ambiguous. Volume changes on mixing are common so that even tie lines are not quite straight. Other methods of expressing ternary compositions such as water tolerances of alcohol-hydrocarbon mixtures used in publications, have required recalculation.

The position of the components are sometimes rearranged from graphs in the original papers, also for uniformity. Water, if present, or another highly polar liquid is always at the lower left hand corner; a hydrocarbon or other component of lowest polarity is at the lower right corner; and the third component, which is usually the most consolute one, is at the top. This arrangement usually results in a binodal curve with widest base on the bottom side. When one component is an inorganic salt, however, water is the consolute component. The same arrangement is used for the order of columns in tables, i.e. that of lower left, top, and lower right corners of the graphs. In the column headings and in the legends to the graphs, however, uniformity is sacrificed to clarity and economy of space. Names are preferred to formulas in order to avoid ambiguity and diminish chance of typographical errors. Space limitations have sometimes required the use of formulas or abbreviated names.

The graphs are intended to be as accurate as practicable, but they are not recommended for scaling of numerical data, especially in view of their necessarily small size and their great number. Numerical data should be taken from the accompanying tables or from the 1941 edition.

Numerous citations are made to distribution coefficients, which are pertinent to solvent extraction, but usually cannot be plotted on triangular diagrams because data are lacking for the effect of the distributed solute on the mutual miscibilities of the sharing solvents. In a few cases a binodal curve without tie lines from one investigation is combined with the distribution coefficients of another to give the complete diagram even though it involves some approximation resulting from lack of density data. When available and not already presented, distribution coefficients are sometimes abstracted in tabular form. In other cases only a reference is given.

The arrangement in the general tables is as formerly by empirical formula according to numbers of atoms of carbon, hydrogen, oxygen, and

other elements in alphabetical order. Systems are listed under each component, but duplication is avoided by cross references. It is hoped that in few cases does this result in omission of data. The data are presented usually with the nonaqueous component of lowest carbon content except in the case of salts, or if the tabulation can be more concise when listed under the other component. Ternary nonaqueous systems are listed three times by cross indexing, but the quaternary systems are so few that one listing is sufficient. When a literature citation is used only once, it is inserted at that point and not repeated in the author index. Other citations are given by author and date only.

The compilation is intended to be critical. Typographical errors found in previous compilations are corrected. These were found usually by the failure of compositions to add to 100%. A few discrepancies between different investigations, and those with theoretical considerations are discussed, and in some cases they were tested experimentally.

The compiler is indebted to Prof. J. C. Smith of Cornell for his lists of two liquid phase systems (1949, 1950) and for several verbal and written suggestions; To Dr. Seidell for supplying numerous microfilms from foreign journals, and for his guidance; and to several colleagues for informal suggestions.

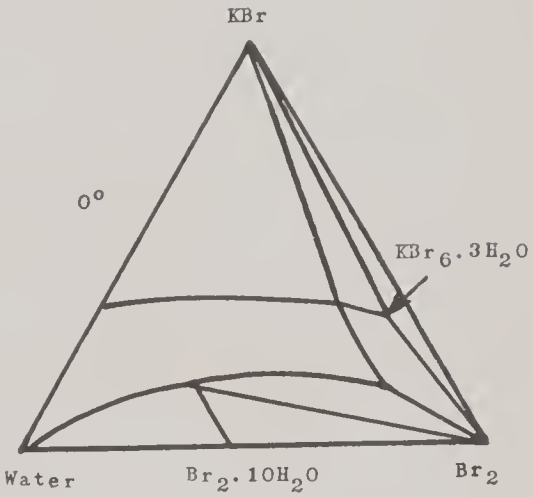
TERNARY AQUEOUS SYSTEMS

(Salts are listed under the nonaqueous liquid)

BROMINE Br_2

Distribution of Solutes Between Water and Bromine

$CdBr_2$ Wilderman, (Z. physik. Chem. 11, 407, 1893); CsBr, HBr, HCl (I 207), H_2SO_4 (I 209), $HgBr_2$ (I 208), KBr (I 208-9, 687) (see figure), KCl, KNO_3, K_2SO_4, NH_4Cl, NH_4NO_3, $(NH_4)_2SO_4$ (I 209), NaBr (I 208), NaCl (I 207, 209), $NaNO_3$, Na_2SO_4, $SrBr_2$ (I 209), CCl_4 (I 210-2), CS_2 (I 211-2), $CHBr_3$, $C_2H_2Cl_4$, C_2HCl_5 (I 211).



CARBON DIOXIDE CO_2

The System Carbon Dioxide-Ammonia-Water (I 1069)

Above 50° two liquid layers are formed. Sample compositions of these are given at several temperatures, but the data are inadequate for constructing a ternary diagram. CORRECTION to (I 1069) Under Liquid Layer I at 70° change 58 to 85% NH_3.

CHLORINE Cl_2

Distribution between water and carbon tetrachloride (I 399).

CHLORINE DIOXIDE ClO_2

Distribution between water and carbon tetrachloride (I 400 ref.).

METAARSENIC ACID $HAsO_3$

Distribution between water and amyl alcohol (I 113).

BORIC ACID H_3BO_3

Distribution between water and amyl alcohol (I 129).

HYDROGEN BROMIDE HBr

Miscible with water up to 81% (monohydrate). See Bromine, Isobutyl alcohol, Isoamyl alcohol. Hydrogen bromide - sulfur dioxide, SO_2. Int. Crit. Tables III 403.

HYDROGEN CYANIDE HCN

Distribution between water and benzene. (I 570).

HYDROGEN CHLORIDE HCl

Miscible with water up to about 64% HCl. (I 571). See Benzene, Bromine, n- and Isobutyl alcohols, m-Cresol, Cyclohexanone, Dioxane, Ether, Isoamyl alcohol, Nicotine, Nitrobenzene, Phenol.

References giving only I or II refer to the volume of Seidell's *Solubilities* 1940-1.

PERCHLORIC ACID $HClO_4$

Distribution between water and ether. (II 274).

HEAVY WATER H_2D

Phenol (II 376). Effect on critical solution temperature.

HYDROGEN FLUORIDE HF

See Propane, n- and Isobutane.

HYDROGEN IODIDE HI

See Isobutyl and Isoamyl alcohols.

NITRIC ACID HNO_3

Distribution between water and n-amyl alcohol, n-butanol, 2-butanone, ether, (I 583), nitrobenzene (Euler and Suanberg, 1917)

HYDROGEN PEROXIDE H_2O_2

Distribution between water and each of nineteen liquids (I 590). **CORECTION** The fractions in the column headings in Brann's table are inverted, i.e., Hydrogen peroxide is more soluble in water than in the organic solvents.

PHOSPHORIC ACID H_3PO_4

See ether, phenol, valeric acid.

HYDROGEN SULFIDE H_2S

Distribution between water and benzene (Int. Crit. Tables III 420).

SULPHURIC ACID H_2SO_4

See Amyl alcohol, Bromine, Ether, Pyridine, m-Cresol, Nitrobenzene, Paraldehyde, Phenol.

IODINE I_2

Distribution Coefficients: CsI (I 460), CCl_4 (I 664-5), CS_2 (I 664-5), $CHBr_3$ (I 664), $CHCl_3$ (I 665-8), C_2HCl_3 (I 666), EtOAc (ICT III 420), $(C_2H_5)_2O$ (I 663), C_2Cl_4 (I 668), C_2H_5Br (I 666), C_2HCl_5, $C_2H_2Cl_4$ (I 668), $C_6H_5NO_2$ (I 666), Tetralin, Decalin (Int. Crit. Tables III 420), Kerosene (M. Korshun, J. chim. ind. (Moscow) 7, 698, 1930; Chem. Abstr. 25, 5822), $C_5H_{12}O$ (I 667), C_6H_6 (I 666), C_7H_8 (I 665).

IODINE CYANIDE ICN

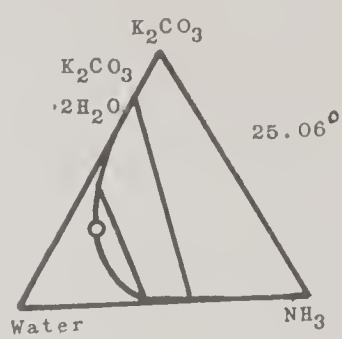
Distribution between water and carbon tetrachloride (I 679).

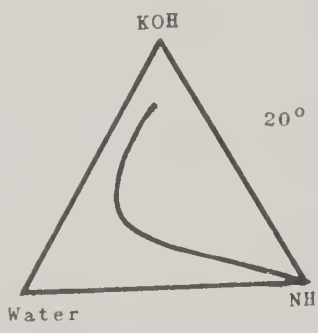
AMMONIA NH_3 See CO_2

Potassium Carbonate, K_2CO_3 (I 731,1037)

Potassium Hydroxide, KOH (I 851,1037)

(E. Jänecke. Z. Elektrochem. 39, 682-6, 1933)





Wt. Per cent		
Water	KOH	NH_3
17.6	70.4	12
27	63	10
35	53	12
41	33.5	25.5
37	24.8	38.2
28.6	10	61.4
15	4	81

Data interpolated

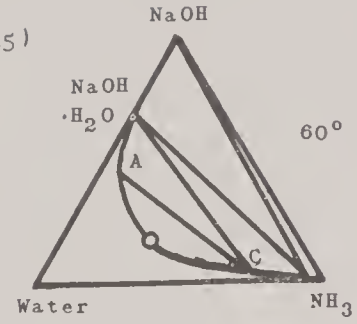
AMMONIA NH_3 (Continued)

NH_3 - Sodium Hydroxide, NaOH

(F. D. Ayers, J. Phys. Chem. 49, 372-4, 1945)

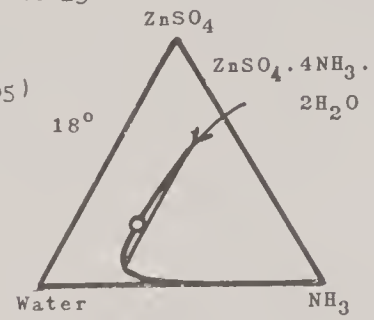
Data at 60° - Wt. per cent

Lower Layer				Upper Layer			
Water	NaOH	NH_3	Pt.	Water	NaOH	NH_3	Pt.
41.0	51.5	7.5	A	19.2	1.4	79.4	C
45.6	39.4	15		31.4	6.8	61.8	
43.8	27.5	28.7		40.5	18.6	40.9	



Numerical data are given also for 50°, 40°, 35° and 25°. (Only one liquid phase at 25°).

NH_3 - Zinc Sulfate, $ZnSO_4$ (I 1595)



NH_3 - Bromoform, Carbon tetrachloride, or Ether

Distribution Coefficients. (Int. Crit. Tables III 420)

NH_3 - $CHCl_3$ and Amyl alcohol.

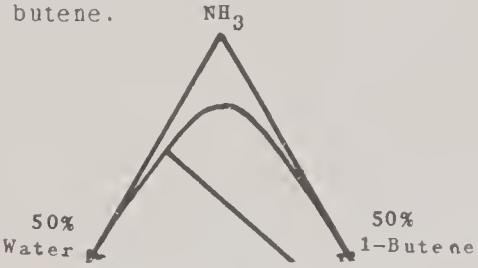
Distribution Coefficients (I 1043-4)

NH_3 - 1-Butene, CH_2:$CHCH_2CH_3$ (Poffenberger, Horsley, Nutting and Britton 1946). Apex at 5% water, 86% NH_3, 9% butene.

Plait pt. at 1% water, 49% NH_3, 50% butene.

Tie lines; NH_3 in

Aqueous	Butene layer
71	10
23	1



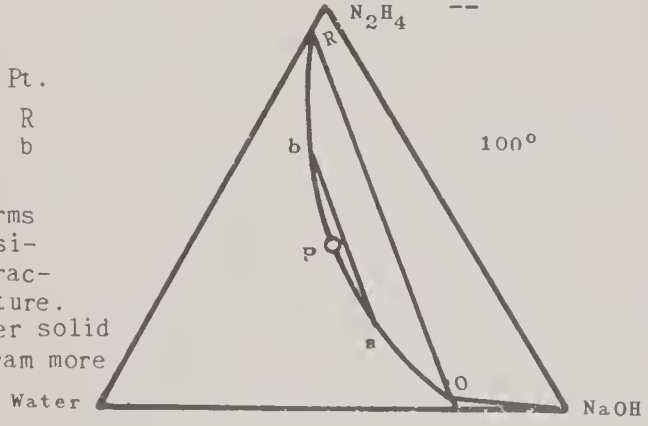
HYDRAZINE NH_2NH_2

(R. A. Penneman and L. F. Audrieth, J. Am. Chem. Soc. 71, 1646, 1949).

Gms. per 100 gms. Solution

Lower Layer			Upper Layer		
N_2H_4	NaOH	Pt.	N_2H_4	NaOH	Pt.
5.7	70.3	O	92.7	2.4	R
23.2	46.1	a	70.6	11.6	b
45.9	27.9	P	Plait Pt.		

Data are given also for isotherms at 90°, 70°, 60°, 50°. The position of the binodal curve is practically independent of temperature. At 60° the appearance of another solid phase, $NaOH \cdot H_2O$, makes the diagram more complex.



HYDRAZINE NH_2NH_2 (Continued)

At 50° and lower, there are no two liquid phases. Two liquid layers were not found in the systems of hydrazine with KOH, K_2CO_3, Na_2SO_4, Na_2CO_3, Na_3PO_4.

SULFUR DIOXIDE SO_2

Ferrous sulfite $FeSO_3$ (I 539).

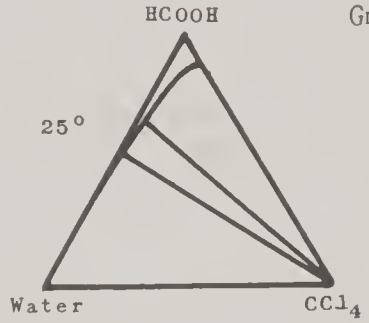
SO_2 - Hydrogen bromide, HBr (Int. Crit. Tables III, 403)

CARBON TETRACHLORIDE CCl_4

Distribution coefficients

Bromine, Br_2 (I 210-2); Chlorine, Cl_2 (I 399);
Chlorine Dioxide, ClO_2 (I 400); Iodine, I_2 (I 664-5);
Iodine Cyanide, ICN (I 679); Ammonia (Int. Crit. Tables III, 420)

CCl_4 - CH_2O_2 Formic acid, HCOOH (II 2,25, 27, 29)

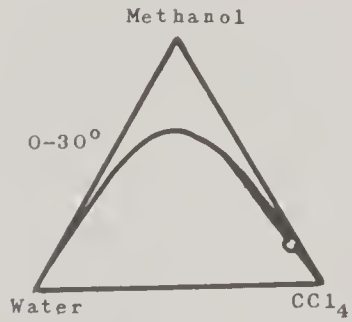


Gms. per 100 gms. Solution, Recalculated.

Water	HCOOH	CCl_4
36.7	62.5	0.8
28.5	70.1	1.4
23.0	75.2	1.8
17.9	79.6	2.5
10.8	85.7	3.5
0.	91.5	8.5
0	2.8	97.2

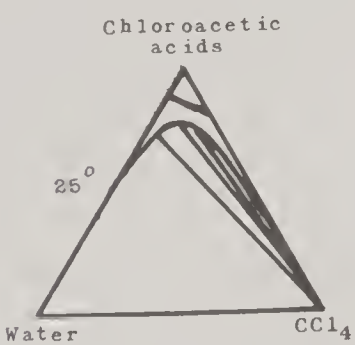
CORRECTION: In the Table (II 2, 3) under "GM. Mol. Percent" read 99.99 instead of 99.9 or 99 (six times).

CCl_4 - Methanol, CH_3OH. (I 215 at 30°, II 3, 45).



Bonner's data at 0° recalculated. Gms. per 100 gms. solution.

Water	Methanol	CCl_4	
47.7	51.0	1.3	
31.0	65.5	3.5	
21.6	64.0	14.4	
14.9	62.7	22.4	
12.5	58.3	29.2	
9.5	52.3	38.2	
5.7	42.5	51.8	
2.0	24.7	73.2	
1.2	17.7	81.1	P.P.



Leikola's data at 20-21° (1940) recalculated, Gms. per 100 gms. solution.

Water	Methanol	CCl_4
37.2	57.1	64.1
26.7	61.0	56.9
20.7	61.0	46.1
14.6	56.8	36.7
10.8	52.5	28.6
7.8	46.1	18.3
5.1	38.0	12.2
3.7	32.2	5.7

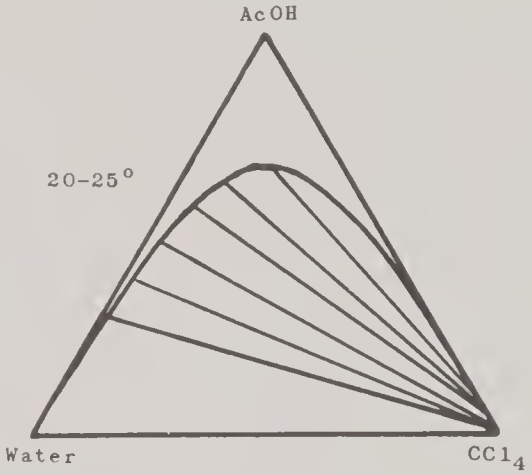
CCl_4 - Trichloroacetic acid, CCl_3COOH (II 68).
CCl_4 - Dichloroacetic acid, $CHCl_2COOH$ (II 78).
CCl_4 - Chloroacetic acid $CH_2ClCOOH$ (II 88, 90).

Only distributions are presented; but concentrations extend up to about 75% by weight in the aqueous layer. In one case it then decreases and in the other two it levels off, indicating the peak of the curve, as shown. The same curve represents all three systems, approximately. The short sloping line near the top represents equilibrium with the solid phase in the cases of mono- and trichloroacetic acids. Additional data on the trichloroacetic acid system are given by Andreasov (1928). **CORRECTION:** On p II 90 the last item under CCl_4 layer should be "0.605" instead of "0.0605".

CCl_4 - Acetic acid, CH_3COOH, AcOH (II 2,105,108)

Smith and Berman's data at 25° recalculated to gms. per 100 gms. solution.

Water	AcOH	CCl_4
99.92	0	0.08
82.7	15.1	2.2
72.4	25.6	2.0
62.5	35	2.5
52.9	44.8	2.3
42.5	55.0	2.5
23.0	68	9.1
15.4	68	16.7
10.8	63.3	25.9
9.5	60.2	30.2
7.8	55.5	36.7
4.9	46.7	48.4
4.2	42.4	53.4
3.2	37.9	58.9
1.4	25.8	72.8
1.03	21.5	77.5
0.7	17.7	81.6
0.27	16.5	83.2



Leikola's data at 20-1° (1940) recalculated to gms. per 100 gms. solution.

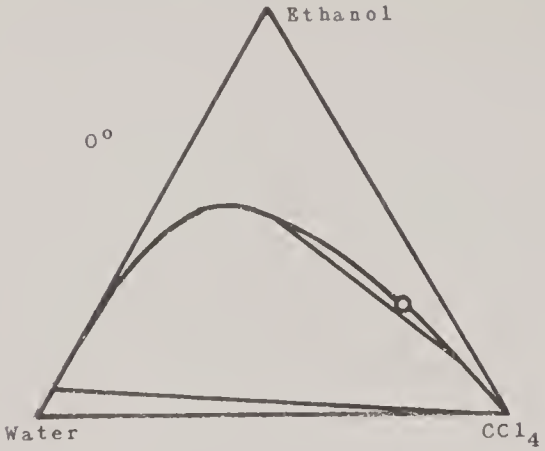
Water	AcOH	CCl_4
29.0	64.6	6.4
13.7	66.4	19.9
6.8	54.8	38.4
1.6	32.8	65.6

The positions of the tie lines are approximate, because the distribution coefficients are given on a volume basis and the densities are not given. **CORRECTION:** On p. II 2 the first item under H_2O should be 31 Gm. Mol. Percent H_2O instead of 33.

Siggia and Hanna (1949) indicated that the graph is similar to that of water-methanol-chlorobenzene which was shown but without numerical data for either system. The apex of their curve was at 62% methanol.

CCl_4 - C_2H_5OCl - Ethyl hypochlorite (II 120)
Distribution only.

CCl_4 - Ethanol, C_2H_5OH, (I 214-5, II 4, 131).



Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	Ethanol	CCl_4
49.3	46.1	4.6
40.5	49.6	9.9
33.6	51.0	15.3
25.4	49.7	24.9
20.4	46.8	32.8
14.4	42.8	42.8
10.4	35.9	53.7
8.0	30.7	61.3

CORRECTION: In the top table on p. I, 215, the word "critical" should be omitted from "critical solubility temperature (six times).

Bonner's data at 0° recalculated to gms. per 100 gms. solution

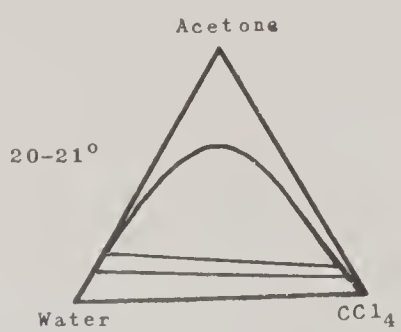
Water	Ethanol	CCl_4	
55.4	42.8	1.8	
45.0	50.0	5.0	
35.6	52.5	11.9	
30.0	50.0	20.0	
20.6	48.5	30.9	
16.5	45.1	38.4	
12.2	39.7	48.1	
6.9	31.0	62.1	
5.7	28.1	66.2	P.P.
5.3	24.8	69.9	
3.1	17.9	79.0	

Tie lines. Wt. % Ethanol in

Aqueous	CCl_4 Layers
50	6
48.7	12
44	17
40	24

CORRECTION: In the top table on II 131 the last item under CCl_4 should be "1.62" instead of "2.55." The latter comes from a typographical error in the original paper.

CCl_4 - C_3H_6O Acetone, $(CH_3)_2CO$, AcMe (II 181).



Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

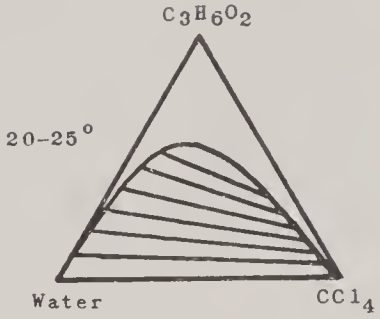
Water	Acetone	CCl_4
1.3	32.9	65.8
7.1	54.7	38.2
22.0	60.3	17.7
42.7	52.1	5.2

CCl_4 - C_3H_6O Allyl alcohol, CH_2:$CHCH_2OH$.
C. H. G. Hands and W. S. Norman, Ind. Chemist 21, 307 (1945).
An abstract paper with no numerical data or graph.

CCl_4 - Propionic acid, $C_3H_6O_2$ (II 3, 187).

Smith and Berman's data at 25° recalculated to gms. per 100 gms. solution.

Water	$C_3H_6O_2$	CCl_4
78.8	19.8	1.4
49.2	48.1	2.7
37.5	55.8	6.7
25.8	56.4	17.8
14.3	51.1	34.6
10.6	49.6	39.8
4.6	40.2	55.2
2.14	33.8	64.1
0.86	25.6	73.5
0.35	21.0	78.7



Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	$C_3H_6O_2$	CCl_4
48.3	47.0	4.7
28.6	54.9	16.5
14.4	50.4	35.2
1.8	32.8	65.4

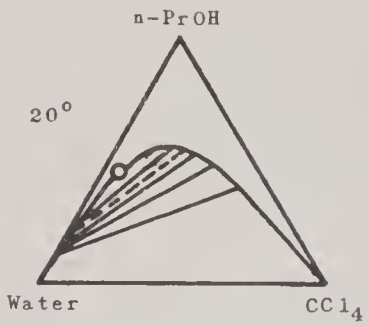
CCl_4 - See Lactic acid, $C_3H_6O_3$, which is listed with acetic acid, $C_2H_4O_2$.

CCl_4 - n-Propanol, C_3H_8O, n-PrOH (II, 205).

C. G. Denzler, J. Phys. Chem. 49, 358 (1945)
Gms. per 100 gms. solution at 20°

Aqueous Layer			CCl_4 Layer		
Water	n-PrOH	CCl_4	Water	n-PrOH	CCl_4
81.74	18.5	0.26	3.9	32.9	63.2
81.0	18.7	0.28	6.9	41.3	51.8
80.1	19.5	0.38	11.2	49.0	39.8
77.8	21.5	0.72	17.9	53.6	28.5
70.2	27.6	2.2[a]	27.1	53.7	19.2
52.3	40.9	6.8	Plait Point		

a. This is the lower layer. The other aqueous layers are the upper ones.



A portion of Bonner's data at 0° recalculated to gms. per 100 gms. solution.

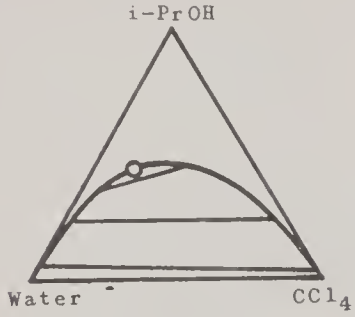
Water	n-PrOH	CCl_4
72.8	26.2	1.0
53.5	40.5	6.0[b]
36.4	51.5	12.1 P.P.
22.4	55.3	22.3[b]
10.3	48.6	41.1
4.5	34.9	60.6
1.9	24.1	74.0

b. These points are conjugate layers.

Leikola's data at 20-21° (1940) recalculated.

Water	n-PrOH	CCl_4
64.5	32.3	3.2
47.8	43.5	8.7
33.7	51.0	15.3
20.2	53.2	26.6
14.6	50.2	35.2
10.2	44.9	44.9
6.5	37.4	56.1
4.6	31.8	63.6

CCl_4 - Isopropanol, $(CH_3)_2CHOH$, i-PrOH

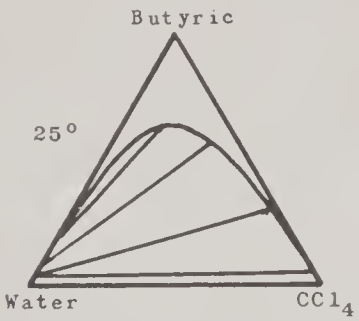


Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	i-PrOH	CCl_4	
42.2	44.5	13.3	
38.7	46.8	14.5	P.P.
24.1	44.6	31.3	
16.0	42.0	42.0	
9.6	36.2	54.2	
6.5	31.2	62.3	

The tie lines are more nearly horizontal than in the n-propanol system. One of them is exactly horizontal at about 24% isopropanol, making the system solutropic.

CCl_4 - n-Butyric acid, $CH_3CH_2CH_2COOH$ (II, 3, 255).



Smith and Berman's data at 25° recalculated to gms. per 100 gms. solution.

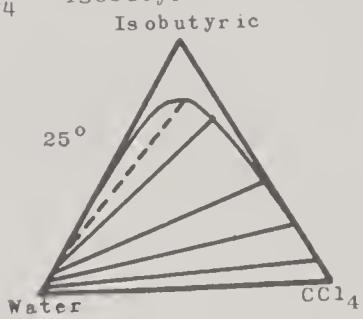
Water	Butyric	CCl_4
79.5	19.8	0.7
38.8	55.1	6.1
22.0	62.9	15.1
16.6	62.3	21.1
8.6	59.8	31.6
4.15	48.85	47.0
1.23	36.8	61.9
0.6	26.2	73.2
0.03	13.0	87.0

Leikola's data at 20-21° recalculated to gms. per 100 gms. solution.

Water	Butyric	CCl_4
41.4	53.3	5.3
18.7	62.5	18.7
6.1	55.2	38.7
0.8	33.1	66.1

In one of the distributions (II, 255) the concentration, 8.5095 mols per liter CCl_4 layer would amount to about 73% acid, which is inconsistent with the data of Smith and Berman and of Leikola. The system is solutropic with a horizontal tie line near the base line.

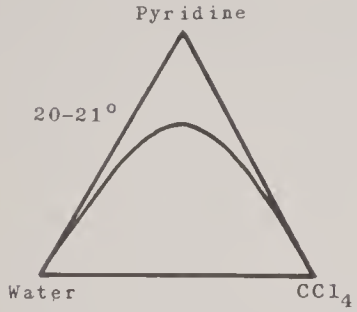
CCl_4 - Isobutyric acid, $(CH_3)_2CHCOOH$ (II, 252, 255).



Only distributions are given. However, the decrease in concentration of acid in the CCl_4 layer with rise in that in the aqueous layer in the last two items (II, 255) indicates passing of the apex of the curve. This permits approximate location of the complete curve. The system is solutropic with a horizontal tie line at about 1% isobutyric acid. It contains also an isopycnic, dashed tie line, connecting compositions with equal densities. Below 23.3° the curve would intersect the left side line (like the valeric acid graph below). Isobutyric acid is the only liquid having such a critical solution temperature with water near room temperature. Cf. II, 250.

CCl_4 - Diethyl amine, $(C_2H_5)_2NH$. (II, 279).

CCl_4 - Pyridine, C_5H_5N

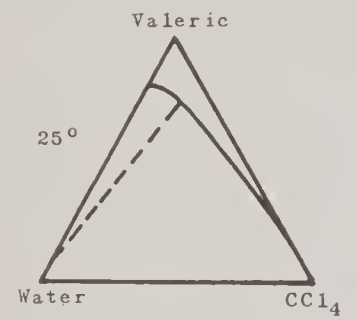


Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	Pyridine	CCl_4
39.8	54.7	5.5
21.4	60.5	18.1
11.5	52.1	36.4
2.6	32.5	64.9

No tie lines are given.

CCl_4 - n-Valeric acid, $CH_3CH_2CH_2CH_2COOH$ (II, 3).



Smith and Berman's data at 25° recalculated to gms. per 100 gms. solution.

Water	Valeric	CCl_4
96.2	3.8	0
14.7	86.3	0
8.3	77.4	14.3
4.05	67.8	28.1
2.65	61	36.3
0.46	48.4	51.1
0.07	11.8	82.1

No tie lines are given, but they would slope steeply toward the water corner. The system has an isopycnic, dashed tie line, connecting compositions of phases with equal densities.

CCl_4 - Isovaleric acid, $(CH_3)_2 CHCH_2COOH$ (II, 304).

Although only distributions are given, the curve must be very similar to that for n-valeric acid, including the isopycnic. The system is also solutropic with a horizontal tie line at about 1% isovaleric acid.

CCl_4 - Phenol, C_6H_5OH (II, 386).

Distribution only.

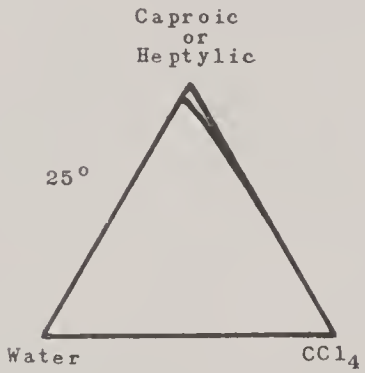
CCl_4- Resorcinol $C_6H_4(OH)_2$ (II 396)

CCl_4 - Aniline, $C_6H_5NH_2$ (II, 416).

Distribution only. **CORRECTION:** In the last column read "0.971" instead of "1.971." The first distribution is very inconsistent with the other two.

CCl_4 - Caproic acid, $C_5H_{11}COOH$ (II, 3, 439).

CCl_4 - n-Heptylic acid, $C_6H_{13}COOH$ (II, 3).



Smith and Berman's data at 25° recalculated to gms. per 100 gms. solution.

Water	Caproic	CCl_4
99	1.0	0
6.4	93.6	0
3.9	87.0	9.1
2.3	77.7	20.0
1.5	68.9	29.7
0.36	47.4	52.3
0.05	22.6	77.3

Water	Heptylic	CCl_4
99.6	0.4	0
3.7	96.3	0
2.15	90.2	7.65
0.72	73.3	26.0
0.28	57.3	42.4
0.03	27.9	72.1

CCl_4 - 1-Hydroxyisocaproic acid, $(CH_3)_2CHCH_2CHOHCOOH$.

Int. Crit. Tables III 428.

CCl_4 - Benzoic acid, C_6H_5COOH (II, 511, Friedrichs (1932).

CCl_4 - p-Toluidine, $CH_3C_6H_4NH_2$ (II, 557). Distribution.

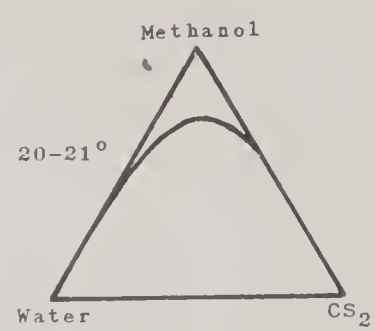
CARBON DISULFIDE CS_2 - Bromine, Br_2 (I, 211).

Distribution

CS_2 - Iodine, I_2 (I, 664-5)

CS_2 - Formic Acid (II 27) Distribution.

CS_2 - Methanol, CH_3OH.



Leikola's data at 20-21° recalculated to gms. per 100 gms. solution.

Water	Methanol	CS_2
26.2	67.1	6.7
14.3	71.4	14.3
9.1	69.9	21.0
4.1	63.9	32.0
0.9	58.3	40.8
0.2	49.9	49.9

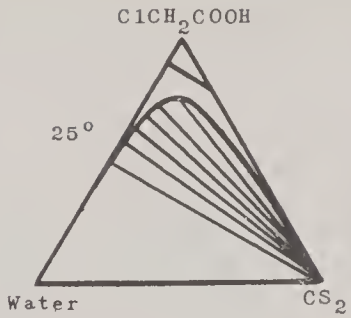
Methanol and carbon disulfide are not completely miscible at room temperature, Cf. I, 239, 240, II, 10. The critical solution temperature is listed as 35.7° to 40.6°. The tie lines would slope steeply toward the CS_2 corner.

CS_2 - Trichloroacetic acid, CCl_3COOH.

Distribution. Andreasov (1928).

CS_2 - Chloroacetic acid, $ClCH_2COOH$ (II, 88).

Only distribution is given, but the leveling of concentration in the aqueous layer with continued rise in the CS_2 layer indicates the peak of the curve at about 76% acid. The short line near the top shows compositions in equilibrium with solid.

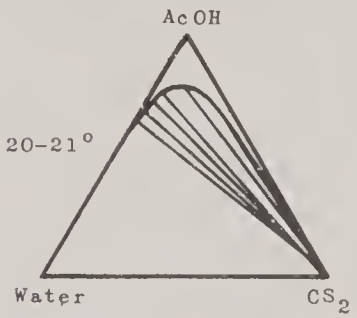


CS_2 - Acetic acid, CH_3COOH, AcOH. (II, 105).

Leikola's data at 20-21° recalculated to gms. per 100 gms. solution.

Water	AcOH	CS_2
13.4	78.7	7.9
3.3	74.4	22.3
0.6	58.4	41.0

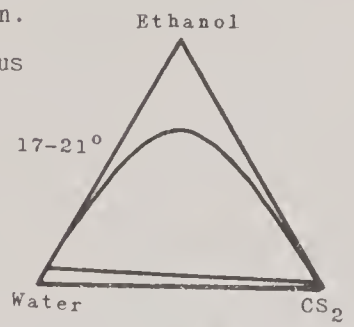
CORRECTION: In the table p II 105 under "G.M.CH_3COOH per 100 cc. CS_2 layer" the column values should be divided by 10, viz. "0.045," etc.



CS_2 - C_2H_6O Ethanol, C_2H_5OH (I, 239, II, 131).

Data recalculated to gms. per 100 gms. solution.

Leikola at 20-21°			Tuchschmidt and Follenius at 17°		
Water	Ethanol	CS_2	Water	Ethanol	CS_2
39.8	54.7	5.5	52.1	47.9	0
28.6	59.5	11.9	50.2	47.1	2.7
20.2	61.4	18.4	19.1	58.1	22.8
10.7	59.6	29.8	11.0	57.9	31.1
6.85	54.8	38.4	4.8	51.7	43.5
4.0	48.0	48.0	3.1	44.7	52.2
2.3	39.1	58.6	1.2	37.7	61.1
1.8	32.7	65.5	0.4	30.0	69.6



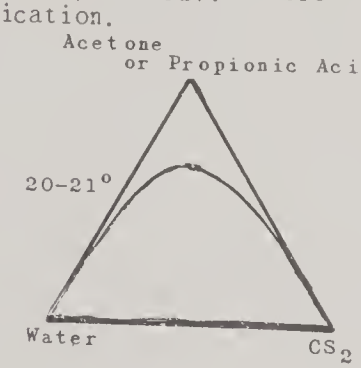
Holmes (1918) gave data for one point, 24.6% water 62.7% ethanol, 12.7% carbon disulfide at 15°.

CORRECTION: In the table at the top of II 131 under "CS_2 layer" read "0.51" and "1.02" instead of "1.87" and "10.23" respectively. There were typographical errors in the original publication.

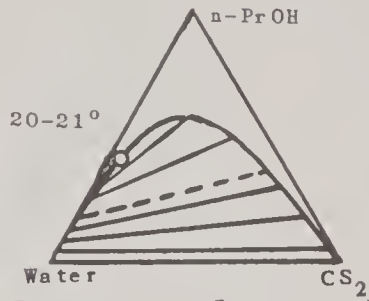
CS_2 - Acetone, $(CH_3)_2CO$.

Data of Leikola at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	Acetone	CS_2
37.2	57.1	5.7
16.7	64.1	19.2
5.0	55.9	39.1
1.0	33.0	66.0



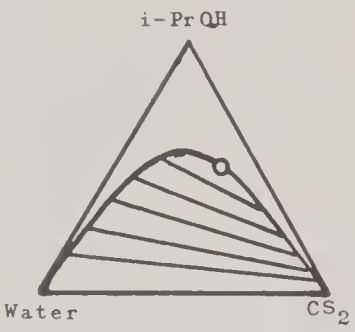
CS_2 - Propionic acid, C_2H_5COOH, EtCOOH



Data of Leikola at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	EtCOOH	CS_2
38.2	56.2	5.6
18.2	62.9	18.9
7.9	54.1	38.0
1.15	33.0	65.85

CS_2 - Propanol and Isopropanol, C_3H_7OH, $CH_3CH_2CH_2OH$ and $(CH_3)_2CHOH$, n-PrOH and i-PrOH.



Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	n-PrOH	CS_2	Water	i-PrOH	CS_2
59.5	36.8	3.7	55.1	40.8	4.1
25.8	57.0	17.2	26.3	56.7	17.0
12.6	51.4	36.0	13.7	50.7	35.6
4.5	31.8	63.7	4.3	31.9	63.8

Holmes (1918) gave data from which can be calculated one point on the binodal curve, 14.6% water, 48.7% n-Propanol, 36.7% CS_2.

CS_2 - Acetic anhydride, $(CH_3CO)_2O$, Ac_2O.

K. I. Mochalov J. Gen. Chem. (U.S.S.R.) 8, 529 (1938); Chem. Abstr. 32, 7333.

Gms. per 100 gms. solution.

Temperature 0°

Water	Ac_2O	CS_2
31.4	65.7	2.9
16.0	69.1	14.9
10.5	59.8	29.7
5.8	68.9	25.3
0.0	78.8	21.2
0.0	3.7	96.3

Temperature 18°

Water	Ac_2O	CS_2
31.0	64.8	4.2
15.1	65.2	19.7
6.6	37.7	55.7
5.5	45.2	49.3
0.0	67.8	32.2
0.0	9.2	90.8

Temperature 24°

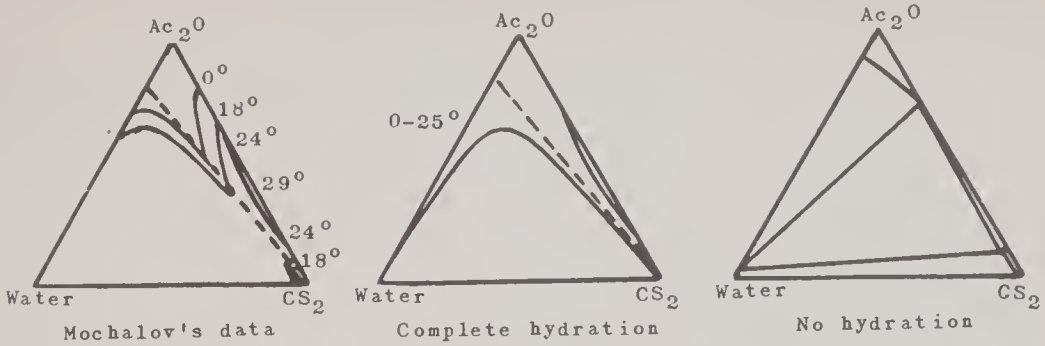
0.0	60.1	39.9
2.9	28.4	68.7
0.9	9.3	89.8
0.0	14.5	85.5

Temperature 29°

0.0	33.2	66.8

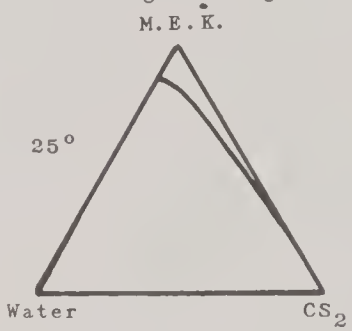
This system and that of acetic anhydride with gasoline (q.v.) are the only two published with two simple intersecting binodal curves. This phenomenon is due to the formation of acetic acid between two of the components, an irreversible reaction of moderate speed. The dotted isologous line from the CS_2 corner to the point corresponding to the composition of acetic acid (85.0% Ac_2O) diyides the triangle into two separate simple systems. However, since acetic acid is miscible with carbon disulfide, the hydration of the anhydride was evidently incomplete during Mochalov's (and Mertslin's) observations, and the graph is only a quasi-equilibrium. With complete hydration (i.e., no simultaneous presence of water and acetic anhydride) the two binodal curves are separate; and with no hydration the system gives three liquid phases (Francis, 1950a).

"It seems to be not generally realized that acetic anhydride is not miscible with water. The physically saturated liquid phases in this binary system contain about 2% and 95% acetic anhydride respectively. They react in a few minutes".



CS_2 - 2-Butanone or Methyl ethyl ketone (M.E.K.) $CH_3COCH_2CH_3$

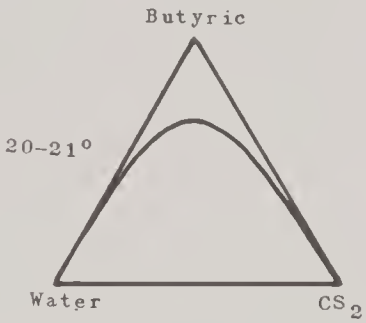
A.S. Smith (1945). No numerical data are given. The graph is shown from the unpublished work of A. R. Jensen. The binary miscibilities of water 2-butanone are 23 and 90% C_4H_8O (II, 243).



CS_2 - $C_4H_8O_2$, n-Butyric acid, $CH_3CH_2CH_2COOH$

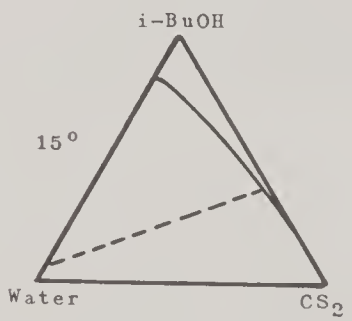
Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	$C_4H_8O_2$	CS_2
30.8	62.9	6.3
13.9	66.3	19.8
4.2	56.4	39.4
0.6	33.1	66.3



CS_2 - Isobutanol, $(CH_3)_2CHCH_2OH$

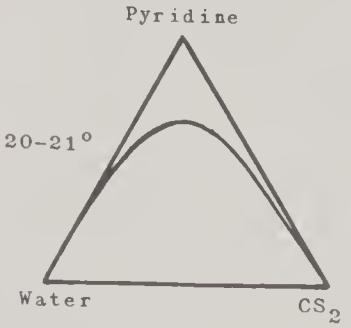
Holmes (1918) gave data from which is calculated one point on the curve, 1.25% water, 19.6% isobutanol, 79.15% CS_2. The points on the left side are the binary miscibilities, 10 and 84% iBuOH (II, 268-9). The position of the isopycnic, dashed tie line, is calculated, to show the two layers of equal densities.



CS_2 - Pyridine, C_5H_5N

Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. Solution.

Water	Pyridine	CS_2
39.8	54.7	5.5
17.7	63.3	19.0
8.1	54.1	37.8
1.8	32.8	65.4



CS_2 - Phenol, C_6H_5OH. Int. Crit. Tables III 429.

The system is solutropic since the distribution is first to the aqueous layer and then to the carbon disulfide layer.

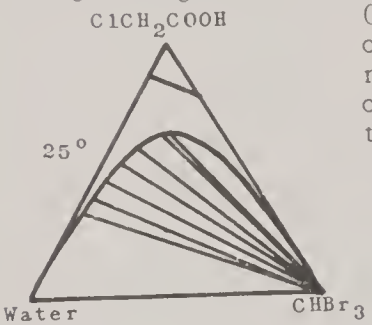
CS_2 - Ethylxanthic acid, $C_6H_{12}O_2S_4$. Halban and Hecht (1918)

$CHBr_3$, Bromoform - Bromine (I, 211).

$CHBr_3$ - Iodine (I, 664).

$CHBr_3$ - CH_2O_2, Formic acid, HCOOH (II, 28).

$CHBr_3$ - $C_2H_3O_2Cl$, Chloroacetic acid, $ClCH_2COOH$. (II, 88).



Only distribution is given, but the leveling of concentration in the aqueous layer with continued rise in the CS_2 layer indicates the peak of the curve at about 70% acid. The short line near the top shows compositions in equilibrium with solid.

$CHBr_3$ - Acetic acid, CH_3COOH (II, 106).

The two pairs of columns are not horizontally interrelated, e.g. 1 G.M. is 60 gm. not 50 gm.

$CHBr_3$ - Picric acid, $C_6H_2OH(NO_2)_3$ (1, 2, 4, 6). (II, 330).

$CHBr_3$ - Phenol, C_6H_5OH. (Int. Crit. Tables III, 428).

The system is solutropic since phenol dissolves first by preference in the aqueous layer and at higher concentrations in the bromoform layer.

$CHBr_3$ - $C_{22}H_{24}BrN$ Tribenzylmethylammonium bromide. Int. Crit. Tables III, 433. The system is solutropic.

$C_{22}H_{24}ClN$ Tribenzylmethylammonium chloride. Ibid.

$CHCl_3$, Chloroform - H_2O_2. Hydrogen peroxide I, 590.

$CHCl_3$ - $HgCl_2$, Mercuric chloride, Hantsch and Sebaldt (1899).

$CHCl_3$ - I_2, Iodine (I, 665-8).

$CHCl_3$ - NH_3, Ammonia (I, 1043-4).

$CHCl_3$ - N_2O_3, Nitrogen trioxide (Int. Crit. Tables III, 420).

$CHCl_3$ - SO_2, Sulfur dioxide (Int. Crit. Tables III, 420).

$CHCl_3$ - CH_2O, Formaldehyde (Int. Crit. Tables III, 422).

$CHCl_3$ - CH_2O_2, Formic acid, HCOOH (II, 27, 29).

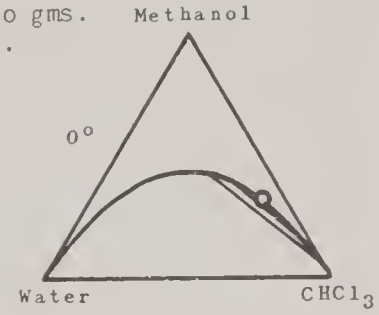
$CHCl_3$ - CH_4O, Methanol, CH_3OH, MeOH (II, 14, 45).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Methanol	$CHCl_3$	
77.9	21.1	1.0	
51.7	42.5	5.8	
43.5	45.6	10.9	
32.8	45.3	21.9	
28.3	43.4	28.3	
23.5	41.1	35.3	
17.2	36.3	46.5	P.P.
13.4	33.0	53.6	
7.4	26.0	66.6	
1.8	13.9	84.3	

Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	Methanol	$CHCl_3$
65.2	31.6	3.2
50.4	41.3	8.3
43.8	43.2	13.0
35.3	43.1	21.6
29.4	41.5	29.1
23.6	38.2	38.2
17.3	33.1	49.6
12.8	29.1	58.1

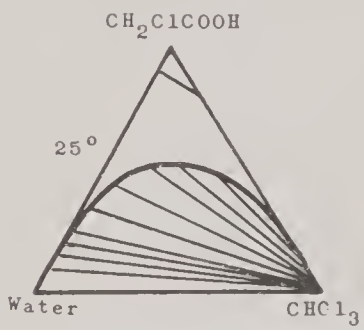


Bonner's tie lines

Methanol in Aqueous	$CHCl_3$ layers
45	7
44	16
43.5	18
42	26.7

$CHCl_3$ - Methyl amine, CH_3NH_2 (II, 64-5)
$CHCl_3$ - Trichloroacetic acid, CCl_3COOH (II, 68), cf. also Andreasov (1928)
$CHCl_3$ - Dichloroacetic acid, $CHCl_2COOH$ (II, 78)
$CHCl_3$ - Bromoacetic acid, $CH_2Br\ COOH$ (II, 86)
$CHCl_3$ - Chloroacetic acid, $CH_2ClCOOH$ (II 88-90)

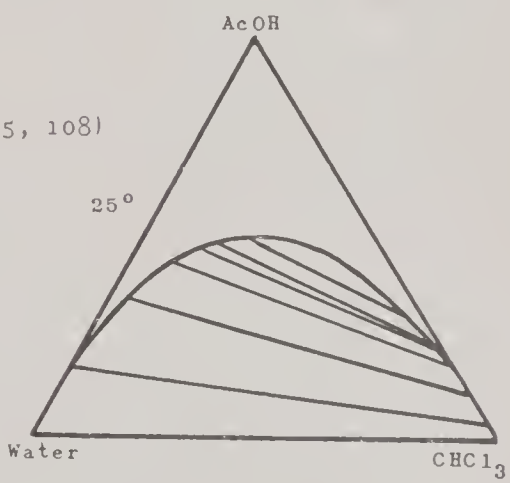
Distribution only, but one additional item in the original, 7.4300 Gm. Equiv. in H_2O layer, 2.5500 in $CHCl_3$ layer, indicates passing of the peak of the curve. Cf. note on p. 839. The short line near the top shows composition in equilibrium with solid acid.



$CHCl_3$ - Iodoacetic acid, CH_2ICOOH (II, 94)
$CHCl_3$ - Acetic acid, CH_3COOH, AcOH (II, 105, 108)
Brancker, Hunter and Nash (1940)

Gms. per 100 gms:

Aqueous Layer			Chloroform Layer		
Water	AcOH	$CHCl_3$	Water	AcOH	$CHCl_3$
81.5	17.4	1.1	0.9	4.1	95.0
63.3	34.1	2.6	1.4	10.8	87.8
48.5	44.5	7.0	2.1	17.9	80.0
38.1	49.5	12.4	3.0	22.6	74.4



$CHCl_3$ - Acetic acid (continued)

This system is one listed by Tarasenkov (1946) and by Tarasenkov and Paulson (1939) illustrating convergence of tie lines to a point on the base line extended, but no new data were presented.
Cf. also Shilov and Lepin 1922.

Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	AcOH	$CHCl_3$
61.1	35.4	3.5
34.9	50.1	15.0
20.6	45.4	34.0
6.2	31.3	62.5

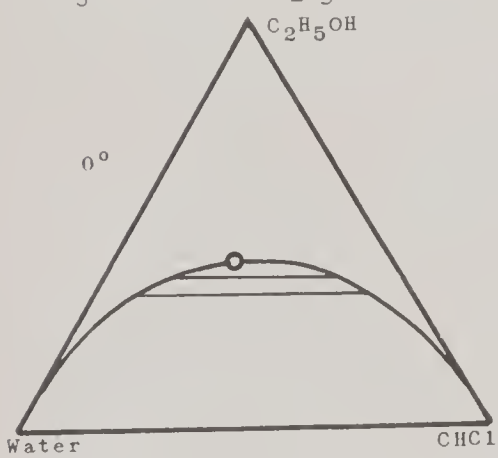
Data for the quaternary system including acetone also are presented as follows: (Biancker, Hunter, and Nash, 1940)

Quaternary Equilibria, Gms. per 100 gms. satd. soln.

Aqueous Layer				Organic Layer			
Water	AcOH	AcMe*	$CHCl_3$	Water	AcOH	AcMe*	$CHCl_3$
71.7	15.3	11.2	1.8	1.6	3.3	31.6	63.5
59.5	32.8	4.6	3.1	1.8	9.6	11.8	76.8
57.1	31.6	7.5	3.5	2.8	9.6	20.3	67.3
57.1	29.9	9.3	3.7	3.3	8.7	29.2	58.8
54.8	30.4	10.9	3.9	4.0	9.2	28.9	57.9
51.4	28.8	15.4	4.4	6.3	9.6	36.8	47.3
44.5	24.2	24.4	6.9	13.7	11.2	44.3	30.8
41.2	38.2	10.8	9.8	6.2	16.2	25.8	51.8
28.3	39.0	13.6	19.1	10.6	24.1	22.8	42.5

*Acetone

$CHCl_3$ - Ethanol, C_2H_5OH, (II, 14, 131)



Bonner's data at 0° recalculated to gms. per 100 gms. solution

Water	Ethanol	$CHCl_3$
56.6	37.9	5.5
48.1	40.1	11.8
41.2	41.2	17.6
34.2	42.4	23.4
33.5	42.2	24.3 PP
28.9	42.1	30.0
17.85	40.5	41.65
12.5	37.5	50.0
6.5	30.4	63.1

Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution

Water	Ethanol	$CHCl_3$
68.5	28.6	2.9
60.3	33.1	6.6
52.9	36.2	10.9
42.3	38.5	19.2
33.8	39.0	27.2
24.2	37.9	37.9
14.4	34.2	51.4
9.1	30.3	60.6

Bonner's tie lines recalculated, Ethanol in:

Aqueous	$CHCl_3$ layer
33	31
38	38
41.5	42

The system is unusual in having a plait point near the apex of the curve, and tie lines nearly horizontal. Probably at least one of them is exactly horizontal making the system solutropic. Bogin (1924) and Miller and McPherson (J. Phys. Chem. 12, 701, 1908) presented additional data on this system.

$CHCl_3$ - Dimethyl Amine $(CH_3)_2NH$ (II, 160)

$CHCl_3$ - Ethyl Amine $C_2H_5NH_2$ (II, 161)

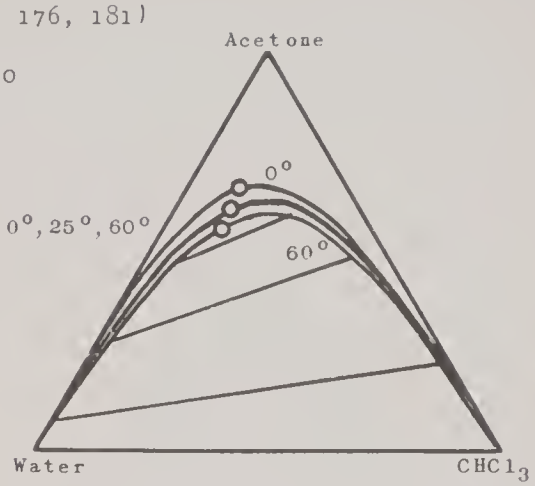
$CHCl_3$ - Dimethyl amine Hydrochloride $(CH_3)_2NH_2Cl$ (Int. Crit. Tables III, 425)

$CHCl_3$ - Alpha, beta-Dibromopropionic acid, $CH_2BrCHBrCOOH$ (II, 165); Pyruvic acid, $CH_3COCOOH$ (II, 166); alpha- and beta-Bromopropionic acids, $CH_3CHBrCOOH$ and CH_2BrCH_2COOH (II, 170); Beta-Chloropropionic acid, CH_2ClCH_2COOH (II, 171); and Beta-Iodopropionic acid, CH_2ICH_2COOH, (II, 172). Distribution coefficients.

$CHCl_3$ - Acetone, $(CH_3)_2CO$, (II 14, 176, 181)

Bonner's data at 0° recalculated to gms. per 100 gms. solution

Water	Acetone	$CHCl_3$	
62.1	31.7	1.2	
41.9	53.4	4.7	
34.4	57.0	8.6	
27.6	60.6	11.8	
21.9	62.3	15.8	P.P.
14.4	64.0	21.6	
7.9	62.0	30.1	
4.3	56.6	39.1	
0.8	33.4	65.8	



Brancker, Hunter and Nash (1940a)

Gms. per 100 gms. solution at 25°

Aqueous Layer			Chloroform Layer		
Water	AcMe	$CHCl_3$	Water	AcMe	$CHCl_3$
96.0	3.0	1.0	1.0	9.0	90.0
90.5	8.3	1.2	1.3	23.7	75.0
81.0	17.4	1.6	2.0	38.0	60.0
66.0	31.9	2.1	4.5	50.5	45.0
51.0	44.5	4.5	8.0	57.0	35.0

Hunter in Ind. Eng. Chem. 34, 963 discussed this system as part of the quaternary system including acetic acid.

W. Reinders and C. H. De Minjer, Rec. trav. chim. 66, 573 (1947).

Gms. per 100 gms.

	Upper Layer			Lower Layer		
Temp.	Water	AcMe	$CHCl_3$	Water	AcMe	$CHCl_3$
25°	94.5	4.6	0.9	0.5	12.3	87.2
	74.5	24.5	1.0	2.0	39.5	58.5
	56.1	41.5	2.4	6.7	56.7	36.6
	49.3	46.7	4.0	9.4	59.6	31.0
	39.5	53.0	7.7	17.4	61.0	21.6
	27.3	58.7	14.0	Plait Point		
60°	91.3	7.8	0.9	0.7	19.6	79.7
	72.0	26.6	1.4	5.7	47.3	47.0
	47.6	45.5	6.9	17.2	57.9	24.9
	32.0	54.0	14.0	Plait Point		

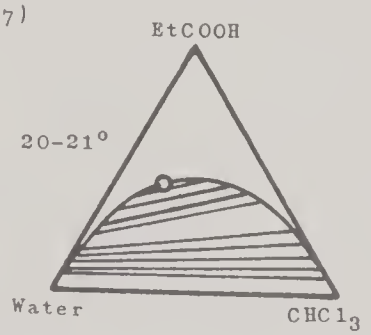
Leikola's data at 20-21° (1940) are consistent with these. Tarasenkov (1946) listed this system to illustrate convergence of tie lines.

$CHCl_3$ - Propionic acid C_2H_5COOH, EtCOOH (II 187)

Leikola's data at 20-21° recalculated to gms. per 100 gms. solution

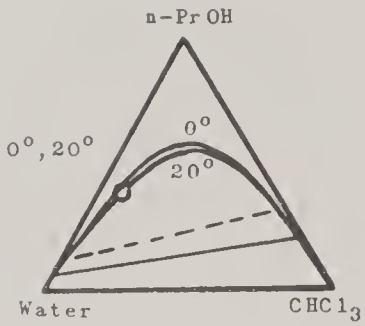
Water	EtCOOH	$CHCl_3$
71.0	26.4	2.6
48.0	40.0	12.0
22.7	45.5	31.8
2.9	32.4	64.7

The system is solutropic with a horizontal tie line at about 7% propionic acid.



$CHCl_3$ - Lactic acid, $CH_3CHOHCOOH$ (II 194). Leonard, Peterson and Johnson (1948).

$CHCl_3$ - n-Propanol, $CH_3CH_2CH_2OH$, n-PrOH (II 205)



Bonner's data at 0°, recalculated to gms. per 100 gms. solution

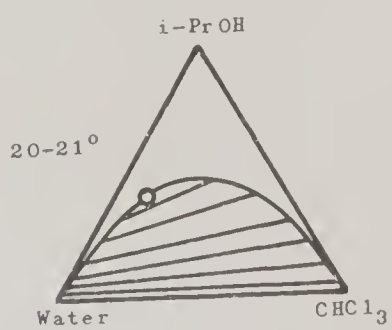
Water	n-PrOH	$CHCl_3$
69.8	28.0	2.2
54.0	40.2	5.8
40.4	49.9	9.7
31.6	55.3	13.1
21.4	57.2	21.4
13.6	54.6	31.8
9.7	51.5	38.8
5.7	43.2	51.1
4.5	38.7	56.8
1.8	23.3	74.9

Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	n-PrOH	$CHCl_3$
65.2	31.6	3.2
44.5	46.3	9.2
30.1	53.8	16.1
18.5	54.3	27.2
13.7	50.7	35.6
9.6	45.2	45.2
6.2	37.5	56.3
4.4	31.9	63.7

The system contains an isopycnic (dashed tie line) in approximately the position shown, connecting compositions of equal density.

$CHCl_3$ - Isopropanol $(CH_3)_2CHOH$, i-PrOH

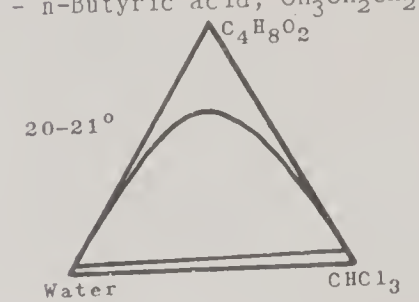


Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	i-PrOH	$CHCl_3$
71.3	26.1	2.6
41.6	44.9	13.5
21.2	45.8	33.0
5.8	31.4	62.8

The system is solutropic, with a horizontal tie line near the base line.

$CHCl_3$ - n-Butyric acid, $CH_3CH_2CH_2COOH$ (II 251, 253)(Shilov and Levin, 1922)



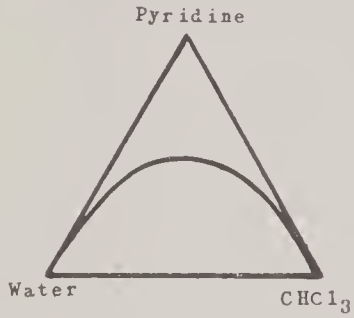
Leikola's data at 20-21° (1940) recalculated to gms. per 100 solution.

Water	$C_4H_8O_2$	$CHCl_3$
37.6	56.7	5.7
18.0	63.1	18.9
6.8	54.8	38.4
1.8	33.7	64.5

$CHCl_3$ - n Butyric acid (continued)

The system is solutropic since at first butric acid dissolves in the aqueous layer, but above 0.3% the concentration is higher in the chloroform layer. The plait point must be low on the left side since the critical solution temperature of butyric acid and water, -3.8°, is not far below room temperature.

$CHCl_3$ - Pyridine, C_5H_5N (II 288) Leikola's data at 20-21° (1940), recalculated to gms. per 100 gms. solution.



Water	Pyridine	$CHCl_3$
65.1	31.7	3.2
36.9	48.5	14.6
15.8	49.6	34.6
2.9	32.4	64.7

Distribution Coefficients between Water and Chloroform

$$K = \frac{\text{Weight per cent in aqueous layer}}{\text{Weight per cent in chloroform layer}}$$

	Solute	Reference	Range in K
C_3H_9N	Trimethyl amine, Me_3N	II 211	0.64 to 0.48
$C_4H_6O_2$	Alpha Crotonic acid, MeCH:CHCOOH	II 221-2	4.7 to 1.28
$C_4H_6O_4$	Succinic acid $C_2H_4(COOH)_2$	II 229	135 to 75
$C_4H_7O_2Br$	Alpha Bromobutyric acid $C_2H_5CHBrCOOH$	II 238	1.68 to 0.79[a]
$C_4H_8O_2$	Isobutyric acid $(CH_3)_2CHCOOH$	II 252-3	4.3 to 0.34[a]
$C_4H_4N_2$	Succinonitrile, $C_2H_4(CN)_2$	II 214	2.55
$C_4H_{10}O$	Ether $(C_2H_5)_2O$	II 14 ref.	
$C_4H_{11}N$	Diethyl amine $(C_2H_5)_2NH$	II 279	0.75 to 0.36
C_5H_5N	Pyridine	II 288	0.28 to 0.13
$C_5H_8O_3$	Levulinic acid, $CH_3CO\ CH_2CH_2COOH$	II 293	25 to 18
$C_5H_8O_4$	Glutaric acid $CH_2(CH_2COOH)_2$	II 293	72 to 55
$C_5H_{10}O_2$	n-Valeric acid $CH_3(CH_2)_3COOH$	II 301-2[b]	0.83 to 0.23
$C_5H_{10}O_2$	Isovaleric acid $(CH_3)_2CHCH_2COOH$	II 303-4	1.6 to 0.06[a]
$C_5H_{11}N$	Piperidine	II 308	0.75 to 0.42
$C_5H_{13}N$	n Amyl amine $CH_3(CH_2)_4NH$	II 318	0.25 to 0.13
$C_6H_3N_3O_7$	Picric acid $C_6H_2OH(NO_2)_3$ (1,2,4,6)	II 330	1.22 to 0.57[a]
C_6H_6O	Phenol, C_6H_5OH	II 386	0.43 to 0.12
$C_6H_{12}O_2$	n-Caproic acid $CH_3(CH_2)_4COOH$	II 438	0.3 to 0.22
$C_6H_{12}O_2$	Isocaproic acid $(CH_3)_2CHCH_2CH_2COOH$	II 438	0.35 to 0.26

Distribution Coefficients between Water and Chloroform

$$K = \frac{\text{Weight per cent in aqueous layer}}{\text{Weight per cent in chloroform layer}}$$

	Solute	Reference	Range in K
$C_6H_{12}O_2S_4$	Ethylxanthic acid	(Halban and Hecht, 1918)	1800
$C_6H_{15}N$	Triethyl amine	II 467	9 to 15
$C_7H_4O_6N_2$	3,5-Dinitrobenzoic acid	II 471-2	2.9 to 1.8
$C_7H_4O_6N_2$	2,4 Dinitrobenzoic acid	II 472	25 to 15
$C_7H_5O_2Br$	o-Bromobenzoic acid	II 474	0.21 to 0.13
$C_7H_5O_2Cl$	o-Chlorobenzoic acid	II 475-6[c]	1.14 to 0.20[a]
$C_7H_5O_2Cl$	m-Chlorobenzoic acid	II 475	0.045 to 0.06
$C_7H_5O_2Cl$	p-Chlorobenzoic acid	II 475	0.07 to 0.12
$C_7H_5O_2I$	o-Iodobenzoic acid	II 478	0.73 to 0.35
$C_7H_5O_4N$	o-Nitrobenzoic acid	II 486-7, 491	9.2 to 2.8
$C_7H_5O_4N$	m-Nitrobenzoic acid	II 486-7	1.22 to 0.19[a]
$C_7H_5O_4N$	p-Nitrobenzoic acid	II 487	0.47 to 0.45
$C_7H_6O_2$	Benzoic acid, C_6H_5COOH	II 510-1	0.63 to 0.11
$C_7H_6O_3$	Salicylic acid HOC_6H_4COOH	II 524-5	1.38 to 0.6[a]
$C_7H_6O_4$	Gentisic acid $(HO)_2C_6H_3COOH$, 2, 5 Dihydroxybenzoic acid	II 531	72 to 64
$C_7H_7O_2N$	Anthranilic acid, o-Aminobenzoic acid	II 540	11 to 8.4
C_7H_9N	Benzyl amine $C_6H_5CH_2NH_2$	II 554	0.12 to 0.09
$C_8H_6O_4$	Piperonylic acid $CH_2:O_2:C_6H_3COOH$	II 572	0.45 to 0.28
$C_8H_8O_2$	Phenylacetic acid $C_6H_5CH_2COOH$	II 582-3	0.88 to 0.70
$C_8H_8O_2$	o-Toluic acid $CH_3C_6H_4COOH$	II 587	0.028 to 0.022
$C_8H_8O_2$	p-Toluic acid	II 587	0.025 to 0.020
$C_8H_8O_3$	o-Methoxybenzoic acid	II 591	0.04 to 0.044
$C_8H_8O_3$	p-Methoxybenzoic acid (Anisic acid)	II 592	0.059 to 0.056
$C_8H_8O_3$	Mandelic acid $C_6H_5CHOHCOOH$ Phenylglycolic acid	II 596	31 to 32
C_8H_9ON	Acetanilide	II 605	0.13
$C_8H_9O_2N$	Methylanthranilic acid	II 606	0.12 to 0.09
$C_8H_{12}O_3N_4$	Caffeine $C_5HMe_3N_4O_2 \cdot H_2O$	II 612-3	0.065 to 0.023
$C_9H_8O_2$	Cinnamic acid $C_6H_5CH:CHCOOH$	II 627	0.017 to 0.015
$C_9H_8O_4$	Aspirin $CH_3COOC_6H_4COOH$, Acetylsalicylic acid	II 631	0.32 to 0.16
$C_9H_{10}O_2$	β.-Phenylpropionic acid, Hydrocinnamic acid	II 634	0.20 to 0.15
$C_{10}H_8O$	β.-Naphthol $C_{10}H_7OH$	II 660	0.025
$C_{10}H_{11}O_3N$	p-Acetoxyacetanilide	II 668 (ref.)	
$C_{10}H_{16}O_4$	Camphoric acid $C_8H_{14}(COOH)_2$	II 681	13 to 2.8
$C_{11}H_{12}ON_2$	Antipyrine $MeN{\cdot}NPhCOCH{:}CMe$	II 687	0.059 to 0.20
$C_{14}H_{12}O_3$	Benzilic acid $Ph_2COHCOOH$	II 749	1.2 to 0.529
$C_{17}H_{19}O_3N$	Morphine	Int. Crit. Tables III 432	112

Distribution Coefficients between Water and Chloroform

$$K = \frac{\text{Weight per cent in aqueous layer}}{\text{Weight per cent in chloroform layer}}$$

	Solute	Reference	Range in K
$C_{17}H_{22}NBr$	Methylpropyl phenyl benzyl ammonium bromide	Int. Crit. Tables III 432	7.4 to 2.6
$C_{17}H_{24}O_3N$	Atropin	II 778	0.26 to 0.04
$C_{18}H_{21}ON_3$	Codeine (against dil NH_4OH)	Marden and Elliott (1914)	0.01
$C_{20}H_{24}O_2N_2\ 3H_2O$	Quinine (against dil NH_4OH)	Marden and Elliott (1914)	Very small
$C_{21}H_{22}O_2N_2$	Strichnine	II 813	0.06 to 0.024
$C_{21}H_{23}O_5N_3$	Strichnine nitrate	II 815	8 to 3
$C_{21}H_{24}O_6N_2S$	Strichnine sulfate	Int. Crit. Tables III 433	0.004
$C_{22}H_{24}BrN$	Tribenzylmethyl ammonium bromide	Int. Crit. Tables III 433	0.41 to 0.058
$C_{28}H_{38}O_{27}$	Cellobios octaacetate	II 825	
$C_{34}H_{47}O_{11}N$	Aconitine (against dil. NH_4OH)	Marden and Elliott (1914)	0.025
$C_{57}H_{104}O_2$	Olive oil, Triolein	Int. Crit. Tables III 422	0

International Critical Tables gives this erroneously as ∞

a) System is solutropic

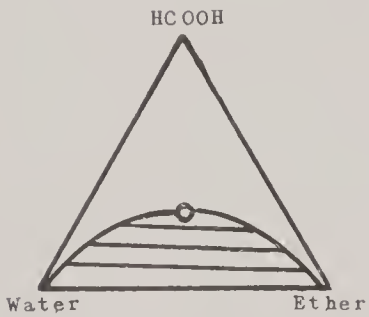
b) **CORRECTION:** Near middle of II 301 under "H_2O layer (C_1)" read "0.390" instead of "0.890."

c) **CORRECTION:** On II 475 in the second table under "H_2O layer" the last four items should be divided by 10.

CH_2Cl_2 - Methylene chloride see C_6H_9ON, Vinyl pyrrolidone
CHO_2Na - Sodium formate - Phenol, Schryver (1910)
CH_2O - Formaldehyde - $CHCl_3$, Chloroform (Int. Crit. Tables III 422) Distribution
CH_2O - $C_4H_{10}O$, Ether II 25
CH_2O - $C_5H_{12}O$, n-Amyl alcohol (Int. Crit. Tables III 422)
CH_2O_2 - Formic acid, HCOOH. See CCl_4, CS_2, Bromoform, Chloroform

FORMIC ACID CH_2O_2

HCOOH - C_4H_8O, 2 Butanone or Methyl ethyl ketone (II 29)
HCOOH - $C_4H_{10}O$, n-Butanol, $CH_3CH_2CH_2CH_2OH$ (II 29)
HCOOH - $C_4H_{10}O$, sec. - Butanol, $CH_3CH_2CHOHCH_3$ (II 29)
HCOOH - $C_4H_{10}O$, Ether, $CH_3CH_2OCH_2CH_3$ (II 27, 28)

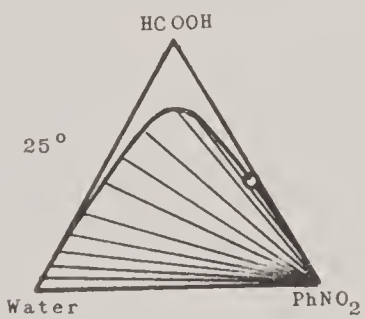


Shilow and Lepin, Z. Phys. Chem. 101, 380 (1922) presented distribution of formic acid in mols per liter as follows:
Temp. not given.

Aqueous layer	Ether layer
0.599	0.236
1.152	0.487
2.261	1.061
4.087	2.391
5.869	4.191
6.434	5.131

The near leveling of the concentration in the aqueous layer indicates approximately the peak of the curve at 32% formic acid, as shown. This has been confirmed experimentally by the compiler.

HCOOH - n-Amyl alcohol $CH_3(CH_2)_4OH$. (II 29)
HCOOH - tert. Amyl alcohol $(CH_3)_2C_2H_5COH$ (II 29)
HCOOH - Petroleum ether (II 31) (Shilov and Lepin, 1922)
HCOOH - $C_6H_5O_2N$ Nitrobenzene, $PhNO_2$ (II 30). The rise and fall in concentration of formic acid in the aqueous layer defines the apex of the curve approximately, as shown.

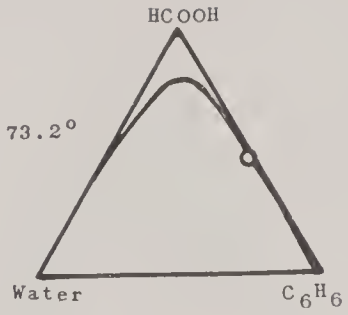


HCOOH - Anhydrous formic acid is miscible with nitrobenzene and most oxygen containing solvents and with chloroform, but not with carbon tetrachloride, carbon disulfide, nor with any hydrocarbon at room temperature.

HCOOH - Benzene, C_6H_6 (II 27, 28, 30)

The following table was calculated to gms. per 100 gms. solution at 73.2°; the binary-critical solution temperature, by interpolation from Ewin's data (II 27).

Water	HCOOH	C_6H_6	
39	58	3	
23.5	70.5	6	
13.8	78.2	8	
4.1	77.9	18	
0	47	53	Plait Pt.
0.26	4.94	94.8	
0.4	2.2	97.4	
0.3	0	99.7	

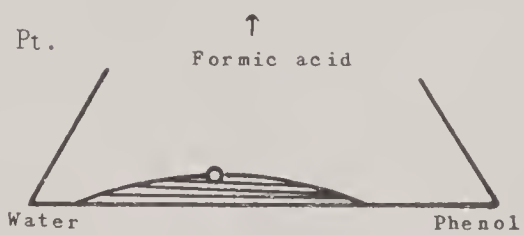


Tie lines are not shown because they practically radiate from the benzene corner.

HCOOH - C_6H_6O, Phenol, C_6H_5OH, PhOH. V. I. Nesterova, N. N. Petin, and K. V. Topchieva, J. Gen. Chem. (U.S.S.R.) 5, 848 (1935)

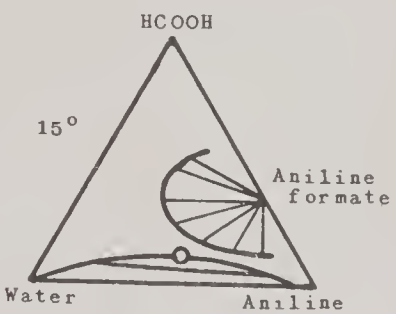
Moles HCOOH per liter		Weight Percentage	
Aqueous	Phenol	Aqueous	Phenol
0.7663	0.572	3.5	2.6
0.8016	0.540	3.7	2.5
1.032	0.596	4.7	2.7
1.241	0.813	5.7	3.7
1.507	Plait Pt.	6.8	Plait Pt.

The plot results from combination of this table with the binary miscibilities of phenol and water (II 373).



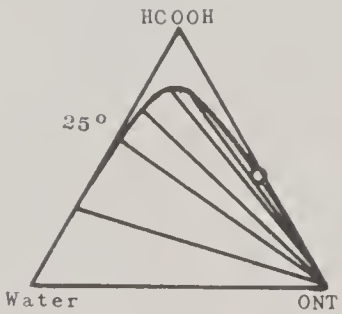
HCOOH - Aniline, $C_6H_5NH_2$ (II 26)

The upper curve shows compositions in weight per cent of liquid in equilibrium with solid aniline formate; the lower one is the binodal curve. The two curves do not intersect at 15°, but doubtless would at some lower temperature.



HCOOH - Isopropyl ether $(C_3H_7)_2O$ (II 112, ref.)

HCOOH - o-Nitrotoluene $CH_3C_6H_4NO_2$ (ONT) (II 31).

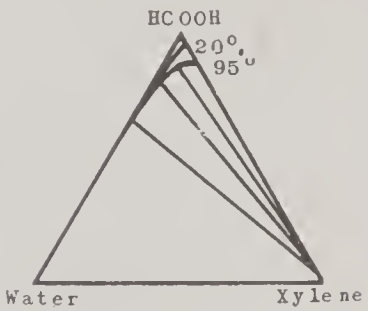


The apex of the curve is indicated by the maximum in concentration of formic acid in the aqueous layer at about 80% formic acid.

HCOOH - C_7H_8, Toluene (II 30)

HCOOH - C_8H_{10}, m-Xylene ($C_6H_4(CH_3)_2$, (II 30)

W. Reinders and Miss C. H. de Minger, Rec. trav. chim., 66, 552 (1947). Data in gms. per 100 gms. solution.



Lower layer at 20°

Water	Acid	Xylene
0.0	96.0[a]	4.0
6.0	91.5	2.5
16.6	82.4	1.0
30.2	69.3	0.5

Lower layer at 95°

0.0	87.8[b]	12.7
5.8	87.5	6.7
16.2	80.4	3.4
29.9	68.6	1.5

a) Upper layer 5.6% acid, water negligible
b) Upper layer 15.1% acid, water negligible

HCOOH - Kerosene (II 30)

HCOOH - Olive oil (II 27 ref.)

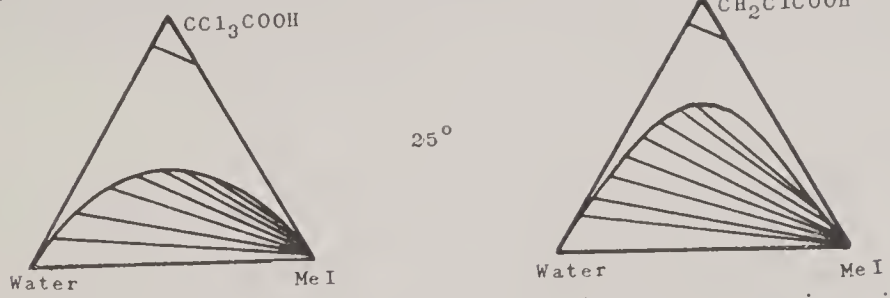
HCOOH - Cottonseed oil (II 27)

METHYL IODIDE CH_3I See n-Caproic Acid

CH_3I, Methyl iodide, MeI - alcohols. Holmes (1918) presented data from which a single point in each system can be calculated, as follows:

Water	Alcohol	MeI
30.0	53.5% MeOH	16.5
14.9	38.1% EtOH	47.0
7.6	25.3% nPrOH	67.1
1.87	20.6% Isobutanol	77.5

CH_3I - Trichloroacetic acid, CCl_3COOH (II 69).
CH_3I - Chloroacetic acid, $CH_2ClCOOH$ (II 90).



In each system the apex of the curve is indicated by a maximum in the concentration of acid in the aqueous layer. These are about 38.5% and 55% acid respectively. That in the chloroacetic acid system occurs at 8.859 Gm. Equiv. (from the original but not copied on II 90). The concentration in the methyl iodide layer is 0.969. The short sloping lines near the top show equilibrium with solid phase.

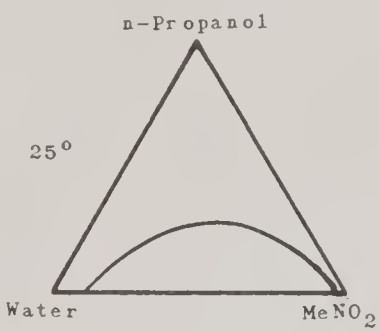
CH_3NO_2, Nitromethane - CdI_2, cadmium iodide. Timmermans (1907).
Effect on critical solution temperature.

NITROMETHANE CH_3NO_2

CH_3NO_2 - Nitromethane, $MeNO_2$ - C_3H_8O, n-Propanol $CH_3CH_2CH_2OH$, n-PrOH
A. R. Fowler and H. Hunt, Ind. Eng. Chem. 33, 90 (1941).

Data in Gms. per 100 gms. solution at 25°.

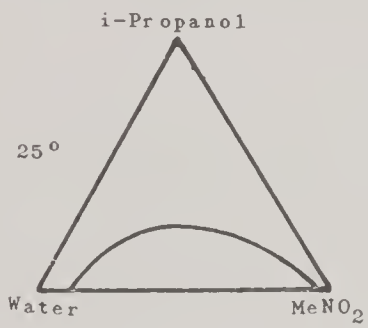
Water	nPrOH	$MeNO_2$
88.97	0.0	11.03
80.0	8.5	11.5
70	15.0	15.0
55.45	20.8	23.75
45.85	23.55	30.6
37.6	24.7	37.6
29.5	26.2	44.2
22.35	25.5	52.15
15.5	22.7	61.8
8.5	14.9	76.6
4.65	7.05	88.3
2.28	0.0	97.72



CH_3NO_2 - C_3H_8O, Isopropanol $(CH_3)_2CHOH$, i-PrOH
J. E. Schumaker and H. Hunt, Ind. Eng. Chem. 34, 701 (1942).

Data in Gms. per 100 gms. solution at 25°.

Water	iPrOH	$MeNO_2$
89.0	0.0	11.0
73.5	13.6	12.9
58.9	21.6	19.5
49.3	24.0	26.7
41.5	24.2	34.3
34.1	24.3	41.6
26.8	23.1	50.1
19.6	21.4	59.0
12.4	17.2	70.4
9.0	13.2	77.8
2.3	0.0	97.7



CH_3NO_2 - C_3H_8O (continued)

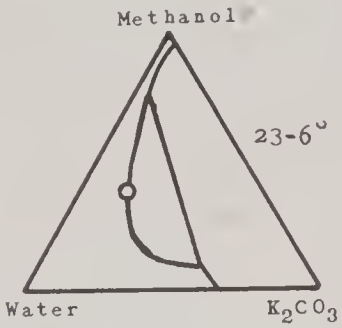
No tie lines or plait points are presented, but the shapes of the curves suggest that the plait points are on the left and right respectively (flatter parts of the curves), indicating a preferential solubility of n-propanol in the nitromethane and of isopropanol in the aqueous layer.

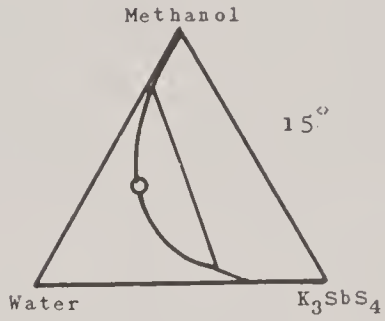
METHANOL CH_4O

CH_4O - Methanol, CH_3OH. See CCl_4, CS_2, $CHCl_3$, C_5H_{10} (trimethyl-ethylene). CH_3I, C_4H_6 (butadiene).

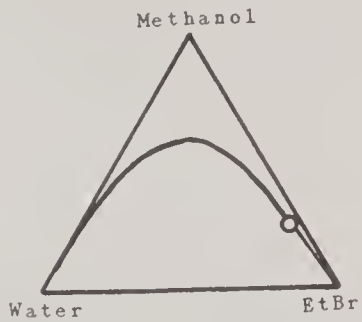
CH_3OH - K_2CO_3, Potassium carbonate (I 736-7).

CH_3OH - K_3SbS_4, Potassium sulfoantimonate (I 857).





CH_3OH - C_2H_5Br, Ethyl bromide (II 48).



Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Methanol	EtBr
81.9	16.3	1.8
46.4	48.4	5.2
36.2	54.7	9.1
26.0	56.7	17.3
18.4	54.1	27.5
10.7	46.3	43.0
6.5	35.0	58.5
4.6	28.2	67.2
2.2	16.8	81.0

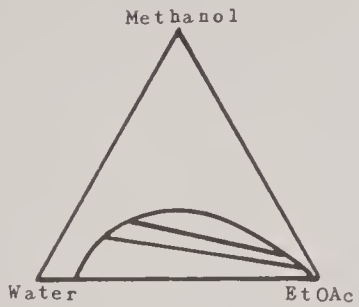
Tie lines recalculated
Methanol in:

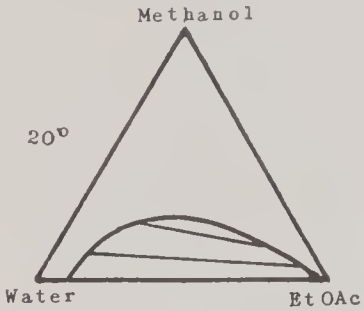
Aqueous	EtBr layer
47	0
39.5	8
36	15
31	17

CH_3OH - C_4H_8, 2-Butene, $CH_3CH{:}CHCH_3$ and Isobutene $(CH_3)_2\,C{:}CH_2$

A. S. Smith and T. B. Braun, Ind. Eng. Chem., 37, 1048 (1945). These systems were studied but no data are reported.

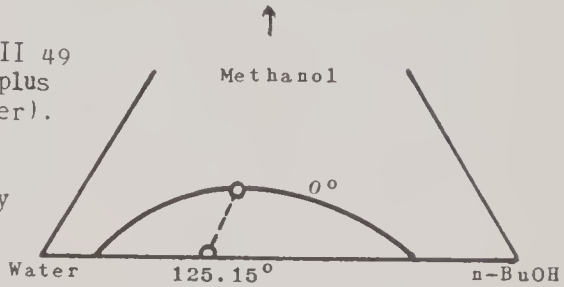
CH_3OH - Ethyl acetate, $CH_3COOC_2H_5$, EtOAc (II 45, 46).





CH_3OH - n-Butanol, $CH_3CH_2CH_2CH_2OH$, nBuOH (II 49).

CORRECTIONS: The table headings on II 49 should read "Gms per 100 gms. water plus n-BuOH in upper layer" (or lower layer). In column 3 at 0° change "79.90" to "69.90." In column 4 at 90° change "5.6" to "5.0." The following binary miscibilities (0% methanol) can be added:



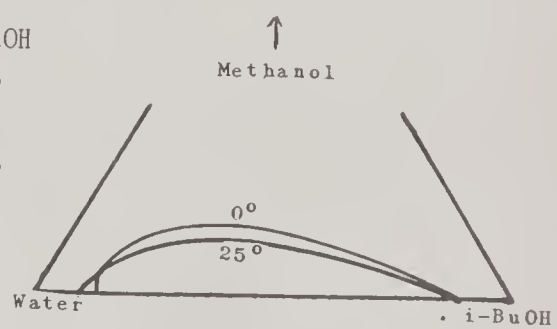
Temp.	Lower Layer		Upper Layer	
	Water	n-BuOH	Water	n-BuOH
0	90.45	9.55	19.62	80.38
15	91.7	8.3	19.9	80.1
30	92.92	7.08	20.6	79.4
125.15(c.s.t.)	67.5	32.5	Binary plait pt.	

The dotted line is the locus of plait points at various temperatures.

CH_3OH - Isobutanol, $(CH_3)_2CHCH_2OH$, iBuOH (II 50, 270).

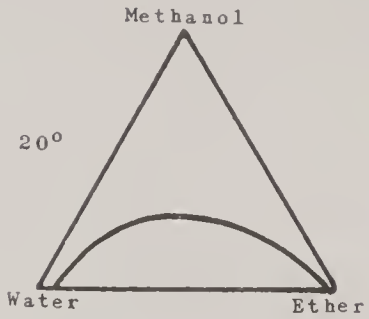
Janecke's data are interpolated to give isotherms, gms. per 100 gms. solution.

At 0°			At 25°		
Water	Methanol	iBuOH	Water	Methanol	iBuOH
87	0	13	92	0	8
89.25	1.75	9.0	83	9	8
75.4	11.9	12.7	68	13	19
61.2	17.6	21.2	56	14	30
38.2	15.6	46.2	23	6	71
15	0	85	17	0	83



No data for plait point or tie lines are reported. At 0° the curve is undercut on the left.

CH_3OH - Ether, $(C_2H_5)_2O$, Et_2O (II 46).



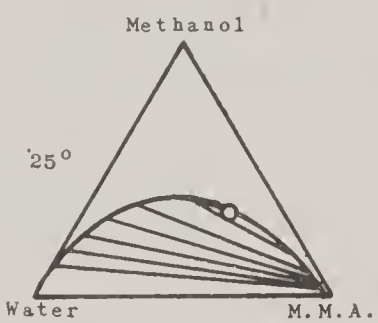
Bancroft's data are recalculated to gms. per 100 gms. solution, together with binary miscibilities. (II 46, 272)

Water	Methanol	Ether
93.5	0	6.5
86	6.9	7.1
76.5	15.3	8.2
67.6	21.6	10.8
59.1	26.2	14.7
37.3	29.8	32.9
28.3	27.2	44.5
17.8	22.2	60.0
10.6	16.2	73.2
5.2	9.5	85.3
1.3	0	98.7

E. Duclaux (Compt. rend., 81; 817 (1876) proposed this system in a "maximum thermometer." Vlček (1935) also studied this system.

CH_3OH - $C_5H_8O_2$, Methyl methacrylate $CH_2{:}C(CH_3)COOCH_3$ "M.M.A."

J. Kooi, Rec. trav. chim. 68, 34 (1949).



Data in gms. per 100 gms. solution.

Lower Layer			Upper Layer		
Water	Methanol	MMA	Water	Methanol	MMA
93.1	6.2	0.7	0.3	1.7	98.0
85.0	13.5	1.5	1.1	3.1	95.8
75.2	21.9	2.9	2.0	5.0	93.0
67.4	28.0	4.6	3.0	6.5	90.5
58.4	33.6	8.0	4.5	10.0	85.5
47.7	36.6	15.7	9.1	15.4	75.5
37.5	35.5	27.0	17.5[a]	25.5	55.5
29.05	32.45	38.5	Plait Pt.		

a) This should be 19.0 to reach 100%.

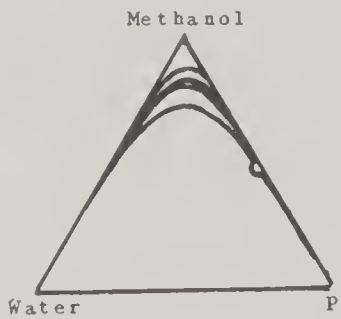
Data for the curves at 0° and 50° are presented without tie lines.

CH_3OH - Petroleum Ether (Rising and Hicks, 1926).

CH_3OH - C_5H_{10}, Mixed pentenes, Francis, (1950).

CH_3OH - C_5H_{12}, n-Pentane, Francis, (1950).

Binodal curves were given which are nearly symmetrical, with the apices at 90% (by weight) methanol for n-pentane at -78°, 84% for pentenes at -78°, 82% for n- pentane at 25°, and 72% for pentenes at 25°.



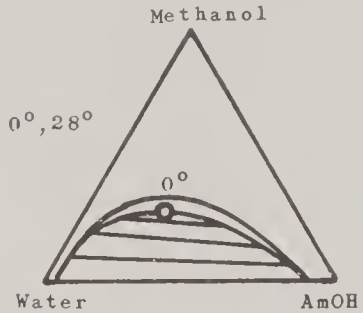
The plait points are far down on the right, about 46% methanol, and the tie lines all point almost toward corner P.

CH_3OH - $C_5H_{12}O$, n-Amyl alcohol, $CH_3(CH_2)_4OH$. Holmes (1918) presented data from which the point 24.0% water, 20.3% methanol, and 55.7% amyl alcohol on the binodal curve is calculated.

CH_3OH - $C_5H_{12}O$, Fermentation amyl alcohol (partly $(CH_3)_2CHCH_2CH_2OH$) (II 313). F. Fontein Z. physik. chem. 73, 212 (1910) also gave isotherms at 0° and 28° in gms. per 100 gms. solution.

At 0°

Water	Methanol	AmOH
83	13.2	3.8
68.2	26.3	5.5
60.3	29.7	10.0
42.9	28.1	29.0
26.5	23.5	50.0
13.8	12.2	74.0
9.5	1.5	89.0
8.9	0	91.1



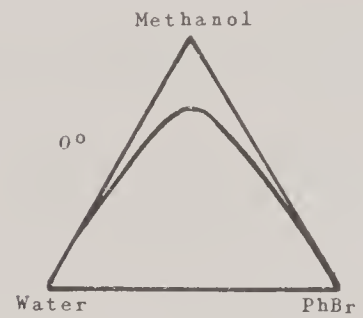
At 28°

Lower Layer			Upper Layer		
Water	Methanol	AmOH	Water	Methanol	AmOH
86.9	10.2	2.9	12.8	5.7	81.5
77.6	18.4	4.0	17.7	12.4	69.9
65.2	25.0	9.8	29.2	20.4	50.4
47.0	25.0	28.0	Plait Pt.		

CH_3OH - Bromobenzene, C_6H_5Br, PhBr (II 48).

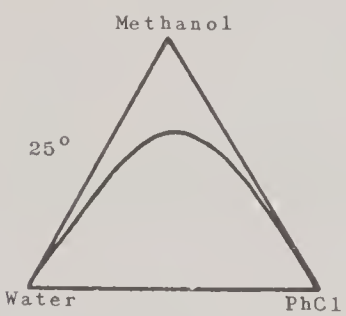
Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Methanol	PhBr	
42.3	57.0	0.7	
30.9	65.9	3.2	
21.4	69.4	9.2	
13.0	67.4	19.6	
8.0	60.0	32.0	
5.0	50.3	44.7	
1.4	28.6	70.0	P.P.
0.7	18.7	80.6	



CH_3OH - C_6H_5Cl, Chlorobenzene, C_6H_5Cl, PhCl. Siggia and Hanna (1949).

A graph is shown but no numerical data and no tie lines or plait point, which would undoubtedly be on the chlorobenzene side. The apex of the curve is at about 62% methanol.

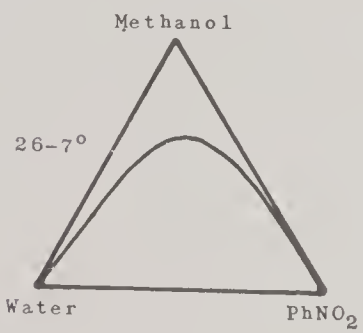


CH_3OH - Nitrobenzene, $PhNO_2$

Leikola's data at 26-27° recalculated to gms. per 100 gms. solution.

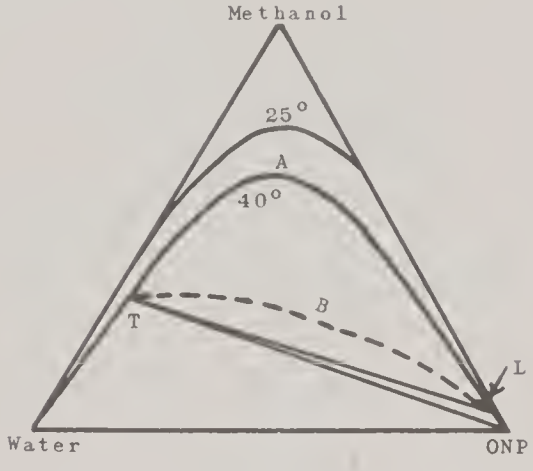
Water	Methanol	$PhNO_2$
41.5	53.2	5.3
22.6	59.6	17.8
11.9	51.9	36.4
5.1	31.6	63.3

Additional data are given by W. W. Henberger (Angew. Chem. 61, 412, 1949)



CH_3OH - o-Nitrophenol, $HOC_6H_4NO_2$ "ONP" (II 362).

In the table on II 362 the "Results at 25°" are compositions of solution in equilibrium with solid o-nitrophenol. At 40° there are two liquid phases in the area above the tie line TL (Up to A). The data reported in Duff's original paper and cited in II 362 give a curved tie line TBL when plotted on a triangular graph. This is impossible, and is hard to explain since the corresponding lines in graphs plotted from five other tables of Duff and coworkers cited on II 362-4 are satisfactorily straight. Compositions are as follows (recalculated):



(gms. per 100 gms. solution)

Point	Water	MeOH	ONP
T	63.5	34	2.5
A	30	56	14
L	0.6	3.1	96.3

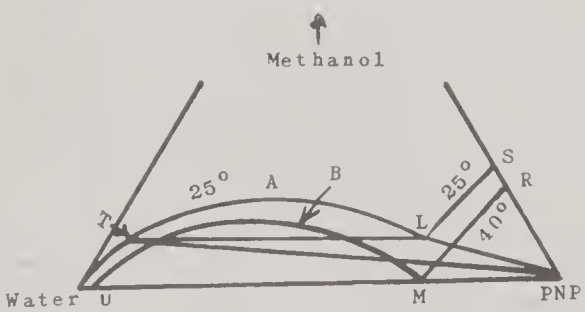
In the narrow triangle below TL are three phases, crystals and two liquids. There is a tiny triangular area below L with crystals in equilibrium with oil.

CORRECTION: In the first table on p. II 361 the symbol ∞ is used incorrectly three times. It should be replaced by "10-90" for Ortho, "40.94" for "Meta" and "33.19" for Para.

CH_3OH - p-Nitrophenol, $HOC_6H_4NO_2$, "PNP" (II 362).

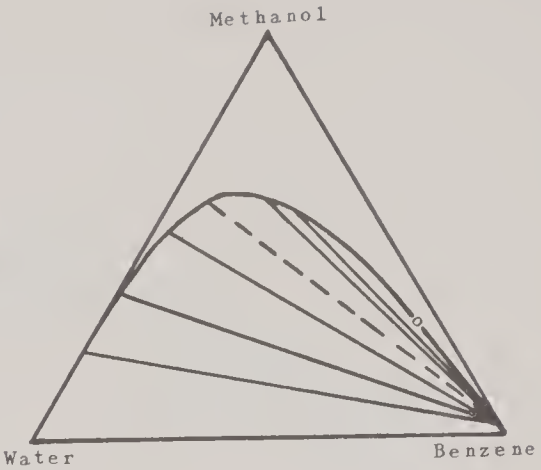
The data are recalculated to a triangular coordinate basis. gms. per 100 gms. solution.

Point	Water	Methanol	PNP
T	84.2	12.05	3.75
A	49	20.8	30.2
L	25.9	8.6	65.4
S	0	26	74
U	97.2	0	2.8
B	51	16.3	32.7
M	28.9	0	71.1
R	0	21.8	78.2



At 25° the triangle TL PNP shows compositions with crystals in equilibrium with two liquids. A and B are apices of the binodal curves at the two temperatures and are near the plait points since the tie lines are almost horizontal. LS and MR are solubility curves of p-nitrophenol crystals in high concentration methanol.

CH_3OH - Benzene C_6H_6 (II 46-7).



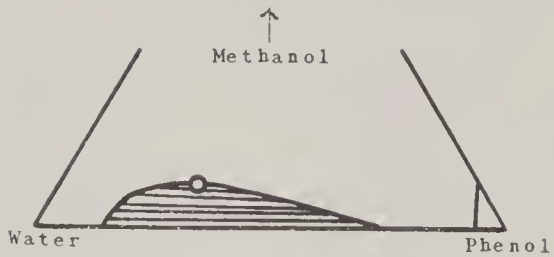
J. Barbaudy, Compt. rend. 182, 1279 (1926) presented a complete curve at 25° with plait point and tie lines including an isopycnic (dashed line) connecting compositions of mixtures with equal density. Only the numerical data marked with an asterisk were tabulated. The other values are scaled from his graph.
gms. per 100 gms. solution

Aqueous Layer			Benzene Layer			
Water	MeOH	C_6H_6	Water	MeOH	C_6H_6	
80	19.5	0.5	0.1	0.5	99.4	Upper layer
62.5	36	1.5	0.1	1.5	98.4	" "
43	53.5	3.5	0.15	3	96.8	" "
28.8*	61.0	10.2	0.28	4.09	95.63	(Isopycnic $d\ \frac{25}{4}$ 0.8700)
26	62	12	0.5	5	94.5	Lower layer
24*	62	14	1	6.5	92.5	" "
20	61.5	18.5	1.2	7.6	91.2	" "
13	55	32	1.5	11	87.5	" "
10.5	52	37.5	2	13	85	" "
9.6*	48.9	41.5	Minimum density		$d\ \frac{25}{4}$ 0.8454	
7.5	44.5	48	2.5	20	77.5	
4.2*	30.8	65	Plait Point		$d\ \frac{25}{4}$ 0.8615	

The observations of Perrakis (II 46) are inconsistent with others. (lower water content).
In the table on II 47 for Sata and Niwase the headings CH_3OH and C_6H_6 should be interchanged. Additional points on the binodal curve of this system are recalculated to gms. per 100 gms. solution from the data of Holmes (1918) (H) at 15°, Ormandy, Pond and Davies (1934) (OPD) at 15°, and Leikola (1940) (L) at 26-27° as follows:

Water	MeOH	Benzene	Author
35.6	58.6	5.8	L
33.8	60.4	5.8	H
25.0	62.5	12.5	L
19.3	62	18.7	L
13.1	57.9	29.0	L
10.1	52.9	37.0	L
7.8	46.1	46.1	L
5.7	37.8	56.5	L
4.5	31.8	63.7	L
2.8	23.6	73.6	OPD
2.0	18.9	79.1	OPD
1.2	14.0	84.8	OPD
0.7	9.3	90	OPD
0.4	6.5	93.1	OPD

Methanol - C_6H_6O, Phenol. Prutton, Walsh, and Desai (1950).

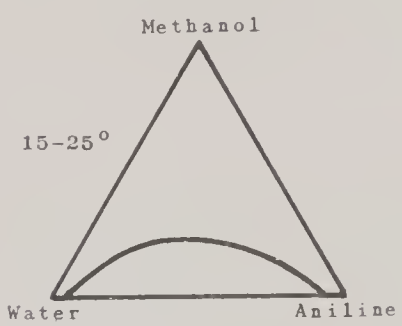


Gms. per 100 gms. at 25°.

Upper Layer			Lower Layer		
Water	Methanol	Phenol	Water	Methanol	Phenol
91.6	0.0	8.4	28.7	0.0	71.3
89.9	1.2	8.9	31.7	1.6	66.7
88.5	2.2	9.3	32.8	2.8	64.4
84.6	4.8	10.6	37.4	4.7	57.9
79.4	8.8	11.8	43.8	7.7	49.5 (48.5)
71.3	11.1	17.4 (17.6)	50.0	10.0	40.0
63.7	12.8	23.5	55.2	11.8	35.3 (33.0)
61.4	12.6	26.0	Plait Point		

The vertical line near the phenol corner, not shown in the original, indicates solid phenol. Its position is approximate. This system is solutropic with a horizontal tie line at 4.4% methanol. Values in parentheses are calculated to reach 100%.

Methanol - C_6H_7N, Aniline, $C_6H_5NH_2$. Holmes (1918) at 15° and Leikola (1940) at 24-5°.



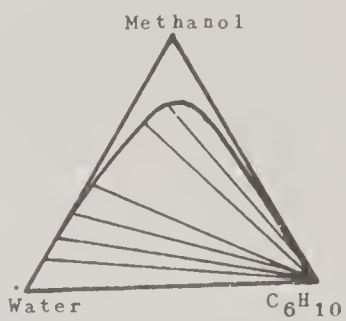
Gms. per 100 gms. solution

Water	Methanol	Aniline	
96.4	0	3.6	II 406-7
69.8	21.6	8.6	Leikola
56.2	25.8	18.0	Leikola
34.4	22.0	43.6	Leikola
22.4	19.9	57.7	Holmes
5.2	0.0	94.8	II 406-7

No data on tie lines or plait point have been found.

Methanol - C_6H_{10}, Cyclohexene.

Washburn, Graham, Arnold, and Transue (1940). Gms. per 100 gms. at 25°.



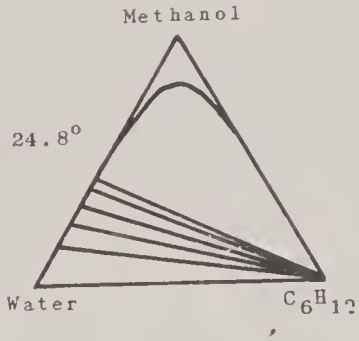
Aqueous Layer			Cyclohexene Layer (Water negligible)	
Water	Methanol	C_6H_{10}	Methanol	C_6H_{10}
90.4	9.6	0.0	0.1	99.9
82.1	17.8	0.1	0.2	99.8
72.9	27.0	0.1	0.2	99.8
68.9	31.0	0.1	0.3	99.7
59.7	40.0	0.3	0.4	99.6
22.2	72.8	5.0	1.2	98.8
14.0	76.0	10.0	2.1	97.9

Data are given also at 15° and 35°.

Methanol - C_6H_{12}, Cyclohexane II 52,54.

CORRECTION: In the table on II 52 the column headings "Gms. CH_3OH" and "Gms. C_6H_{12}" should be interchanged (twice). The gms. per 100 gms. solution (recalculated) are as follows:

Water	Methanol	C_6H_{12}	
77.5	22.4	0.1	
64.2	35.6	0.19	
53.6	46.1	0.33	
38.7	60.4	0.86	
26.7	71.5	1.76	
20.6	76.4	3.0	
17.05	78.5	4.45	
13.7	80.15	6.15	
9.05	81.9	9.05	
5.1	80.4	14.5	
3.7	77.6	18.7	
1.23	72.5	26.3	
0.44	1.56	98.0	Upper layer
0.18	0.90	98.9	" "

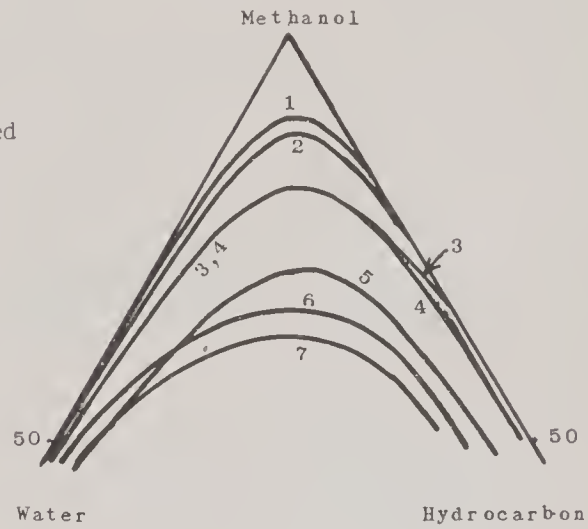


The curve intersects the right side at about 64%, and 4% methanol.

Methanol - C_6H_{14}, n-Hexane II 48

Bonner's data at 0° are recalculated to gms. per 100 gms. solution.

Water	Methanol	Hexane
35.7	63.9	0.4
18.0	80.0	2.0
12.4	84.5	3.1
9.8	86.0	4.2
6.9	86.4	6.7
5.6	86.0	8.4
3.2	84.0	12.8
1.3	80.3	18.4



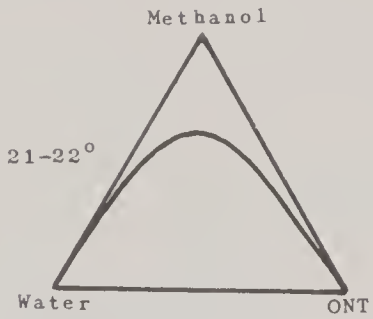
Cf. also Rising and Hicks (1926) and Freed (1933).

The figure shows the upper half of methanol-hydrocarbon systems, namely

1. n-Heptane
2. n-Hexane
3. Cyclohexane
4. n-Pentane
5. Mixed pentenes
6. Toluene
7. Benzene

The first three hydrocarbons, being incompletely miscible with methanol, have no plait points. Those of the last four are below the 50% methanol point on the right side. All of the tie lines slope steeply down toward the right since methanol dissolves mostly in the aqueous layer.

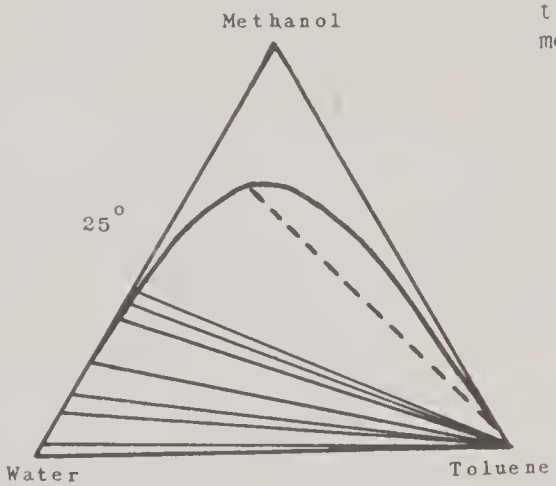
Methanol - $C_7H_7O_2N$, o-Nitrotoluene, $CH_3C_6H_4NO_2$(ONT).



Leikola's data at 21-22° recalculated to gms. per 100 gms. solution.

Water	Methanol	ONT
32.9	61.0	6.1
16.7	64.1	19.2
8.7	53.8	37.5
6.6	46.7	46.7

Methanol - C_7H_8, Toluene II 50.



Mason and Washburn gave data for the tie lines. Weight percentage of methanol in:

Aqueous	Toluene Layer
2.5	0.0
10.1	0.1
15.4	0.2
22.0	0.2
32.2	0.4
40.6	0.8
42.8	2.2

The system has an isopycnic (dashed tie line) connecting compositions of equal density.

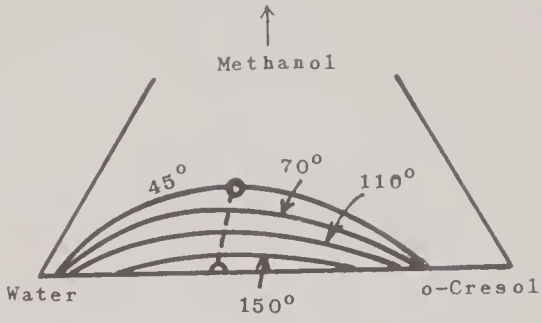
The data of Leikola (1940) at 20-21° are recalculated to gms. per 100 gms. solution.

Water	Methanol	Toluene
27.1	66.3	6.6
19.5	67.1	13.4
14.5	65.8	19.7
9.9	60.1	30.0
7.6	54.4	38.0
5.6	47.2	47.2
4.0	38.5	57.5
3.1	32.3	64.6

Additional data are given by Ormandy, Pond and Davies (1934) at 15°.

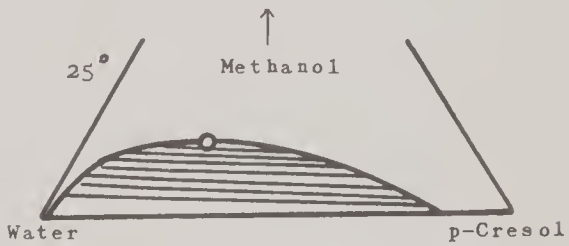
Methanol - C_7H_8O, o-Cresol II 51,549

Isotherms at 45°, 55°, 70°, 85°, 95°, 110°, 120°, 130°, 140°, 150°, 160°. The critical solution temperature is at 169.7° and 60.5% water. The plait points are near the apices of the curves and the tie lines are nearly horizontal.



Methanol - C_7H_8O, p-Cresol

Prutton, Walsh, and Desai (1950)



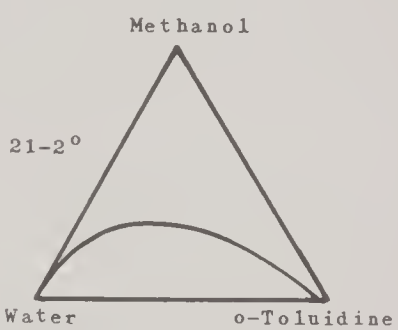
Gms. per 100 gms.

Upper Layer			Lower Layer		
Water	Methanol	Cresol	Water	Methanol	Cresol
97.3	0.0	2.7	13.6	0.0	86.4
89.0	8.0	3.0	15.5	2.5	82.0
85.0	11.7	3.3	19.3	7.3	73.4
78.0	16.7	5.3	26.0	14.0	60.0
70.7	20.1	9.2	34.0	18.0	48.0
53.7	21.3	25.0			
			46.1	20.2	33.6

Methanol - C_7H_9N, o-Toluidine, $CH_3C_6H_4NH_2$

Leikola's data at 21-2° (1940) recalculated to gms. per 100 gms. solution.

Water	Methanol	o-Toluidine
65.6	28.7	5.7
57.5	32.7	9.8
42.9	33.6	23.5
37.0	31.5	31.5

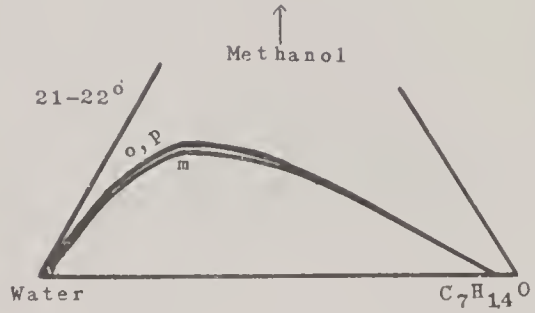


From the shape of the curve the plait point is probably on the right and the tie lines slope down toward the right. Above 24.5° the system has an isopycnic or tie line connecting compositions of equal density. This is near the base line.

Methanol - m-Toluidine

Mondain-Monval and Quiquarez (1940) listed this system as one containing an isopycnic.

Methanol - $C_7H_{14}O$, Methylcyclohexanols



Data of Leikola at 21-2° (1940) recalculated to gms. per 100 gms. solution.

Water	Methanol	$C_7H_{14}O$	
60.0	36.4	3.6	ortho
52.5	36.5	11.0	"
41.5	34.4	24.1	"
27.4	24.2	48.4	"
67.0	30.0	3.0	meta
56.2	33.7	10.1	"
44.2	32.8	23.0	"
28.6	23.8	47.6	"
62.4	34.2	3.4	para
55.8	34.0	10.2	"
41.8	34.0	24.2	"
30.2	23.3	46.5	"

Methanol - C_7H_{16}, n-Heptane II 48

Bonner's data recalculated to gms. per 100 gms. solution.

Water	Methanol	Heptane	Water	Methanol	Heptane
24.3	74.7	1.0	4.3	89.2	6.5
16.7	81.4	1.9	3.6	88.0	8.4
10.4	87.0	2.6	2.8	86.4	10.8
8.0	88.6	3.4	1.5	84.7	13.8
6.2	89.7	4.1	0.6	82.7	16.7
5.1	89.8	5.1			

For graph see Methanol - n-Hexane.

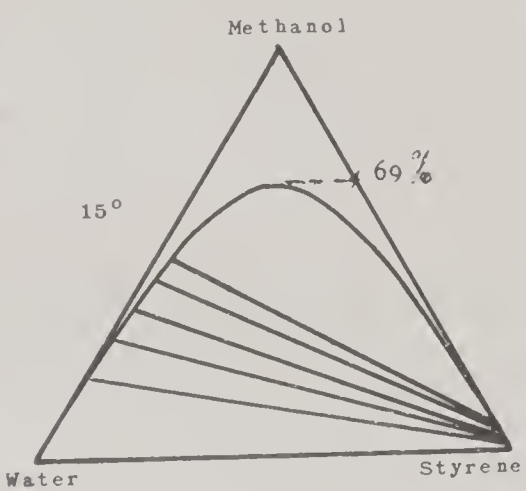
Methanol - Gasoline

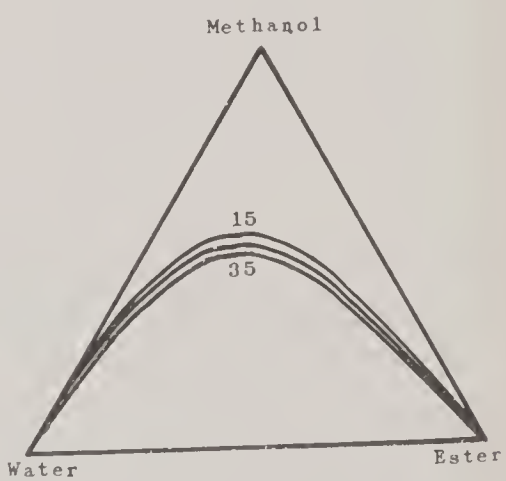
Ormandy, Pond, and Davies (1934), Water tolerance of gasoline containing methanol Cf. also Crismer (Bull. Soc. chim. Belg. 18, 18, 1908) and Othmer and Tobias (1942a)

Methanol - C_8H_8, Styrene, $C_6H_5CH{:}CH_2$ J. E. Troyan, Rubber Age 63, 594 (1948). A graph was presented but without numerical data.

Methanol - $C_8H_8O_2$, Methyl benzoate, $C_6H_5COOCH_3$ (II 52,585)

Isotherms at 15, 25, and 35° but no tie lines.

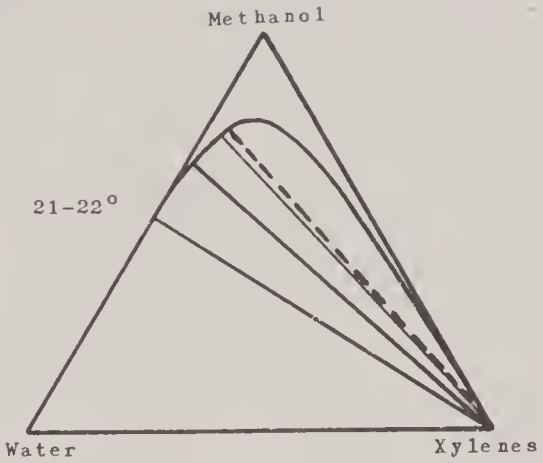




Methanol - C_8H_{10}, Xylenes, $C_6H_4(CH_3)_2$

Leikola's data at 21-2° (1940) recalculated to gms. per 100 gms. solution.

Water	Methanol	Xylene	
22.2	70.7	7.1	ortho
10.3	69.0	20.7	"
5.0	55.9	39.1	"
2.4	32.6	65.0	"
21.7	71.2	7.1	meta
10.0	69.3	20.7	"
5.0	55.9	39.1	"
2.4	32.6	65.0	"
22.0	70.9	7.1	para
10.8	68.5	20.7	"
5.2	55.8	39.0	"
2.6	32.5	64.9	"



One curve suffices for all three isomers.

The system has an isopycnic (dashed tie line) connecting compositions having equal densities.

Methanol - m-xylene (cont.) J. Hartley, J. Soc. Chem. Ind. 69, 60 (1950). Isotherms at 20, 30, and 50°.

Gms. per 100 gms. solution

At 20°			At 50°		
Water	Methanol	Xylene	Water	Methanol	Xylene
0.7	18.5	80.8	0.8	9.2	90.0
2.8	46.5	50.7	1.2	18.4	80.5
7.1	66.6	26.4	5.9	54.5	39.6
13.5	73.5	13.0	12.0	67.5	20.5
24.5	70.6	5.0	30.4	66.0	3.6
49.7	49.2	1.0	43.4	55.6	0.9

The effect of temperature is slight.
Tie lines: Weight per cent of methanol at 20° in:

Aqueous layer	47.3	62	70
Xylene layer	1.7	1.8	2.3

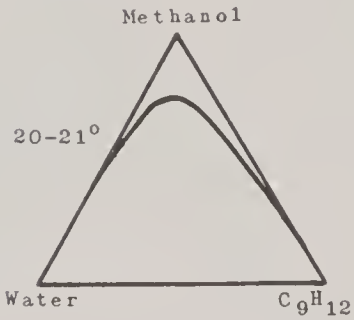
Isopycnics (dashed tie line) connecting compositions having equal densities:

	Aqueous Layer			Xylene Layer		
Temp.	Water	Methanol	Xylene	Water	Methanol	Xylene
20	22.2	72.1	5.7	0.2	3.3	96.5
30	21.7	71.5	6.8	0.2	3.5	96.3
50	21.0	70.2	8.8	0.4	5.0	94.6

Methanol-$C_8H_{11}N_1$ 2,4 Xylidine (Mondain-Monval and Quiquarez 1940a), Isopycnic.

Methanol - C_9H_{12}, Mesitylene, $C_6H_3(CH_3)_3$ (1,3,5):

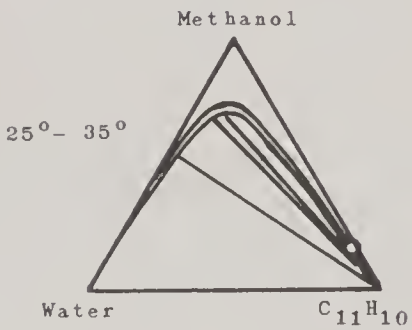
Leikola's data at 20-1° recalculated to gms. per 100 gms. solution.



Water	Methanol	Mesitylene
16.0	76.4	7.6
8.8	75.9	15.3
0.6	33.1	66.3

Methanol - $C_{11}H_{10}$, Methylnaphthalene, mostly 1-, but thought to contain 5 to 10% 2-methylnaphthalene.

Prutton, Walsh, and Desai (1950). Gms. per 100 gms. solution.



The position of the plait point (not shown in the original) is between 10 and 15% methanol.

	Upper Layer		Lower Layer (Water Negligible)	
Water	Methanol	$C_{11}H_{10}$	Methanol	$C_{11}H_{10}$
		At 25°		
100	0	0.0	0	100
46.2	53.8	0.0	1.2	98.8
24.0	73.0	3.0	1.8	98.2
18.0	75.5	6.5	2.5	97.5
13.8	75.2	11.0	3.0	97.0
7.6	72.8	19.6		
3.4	58.0	38.6		
2.2	53.0	44.8		
		At 35°		
46.2	53.8	0.0	1.2	98.8[a]
24.0	72.0	4.0	1.8	98.2
18.0	74.5	7.5	2.5	97.5
10.0	73.6	16.4		
5.4	64.9	29.7		
2.4	45.4	52.2		
0.8	20.6	78.6		
0.0	15.6	84.4		
			5.4	94.6
			10.3	89.7

a) In the original this is given as 99.8, doubtless a typographical error.

Methanol-$C_{11}H_{16}$ Butyltoluene (Mondain-Monval and Quiquarez 1940a), Isopycnic

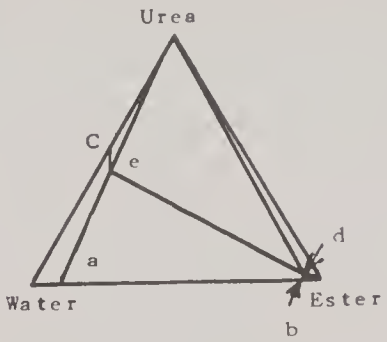
Methanol - Paraffin oil (Int. Crit. Tables III 400). The critical solution temperature of methanol with oil is raised 7.5° by 0.55% water.

Methanol - Olive oil (Int. Crit. Tables III 422).
Distribution coefficient.

Methanol - Cottonseed oil (II 48).
Distribution coefficient, 81 to 94 on a volume basis.

CH_4ON_2 - Urea, $CO(NH_2)_2$ with Ethyl Acetate, $CH_3COOC_2H_5$

Equilibrium of urea crystals with two liquid phases is reported. Compositions in gms. per 100 gms. solution at 25°.



Point	Water	Urea	Ester	Ref.
a	91.92	0	8.08	II 244
b	3.30	0	96.7	II 244
c	45.2	54.8	0	II 55
d	3.234	0.343	96.42	II 58
e	Not reported.			

CH_5N, Methyl Amine, CH_3NH_2.

Distribution between water and n-amyl alcohol, benzene, chloroform, ether, toluene, and xylene. (II 64, 65).

C_2Cl_4 - Tetrachloroethylene, $Cl_2C:CCl_2$.

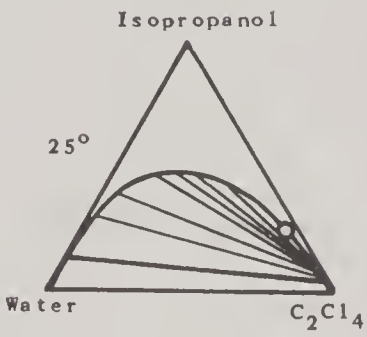
Distribution between water and tetrachloroethylene, of iodine (I 668), acetone (II 181), phenol (II 386).

C_2Cl_4 - Isopropanol $(CH_3)_2CHOH$.

O. Bergelin, F. J. Lockhart, and G. G. Brown. Trans. Am. Inst. Chem. Engrs. 39, 173 (1943).

Gms. per 100 gms. Solution at 25°

Upper Layer			Lower Layer		
Water	i-PrOH	C_2Cl_4	Water	i-PrOH	C_2Cl_4
86.96	13.04	0.0	0.0	0.6	99.4
69.5	29.8	0.7	0.2	4.35	95.45
60.3	37.4	2.3	0.4	6.6	93.0
44.6	46.7	8.7	0.7	8.5	90.8
27.5	49.5	23.0	1.2	11.5	87.3
21.3	48.1	30.6	1.5	13.6	84.9
14.4	42.8	42.8	2.4	17.6	80.0
5.4	26.4	68.2	Plait Point		



$C_2O_2Cl_3Na$ - Sodium Trichloroacetate, - with Phenol.

Schryver (1910).

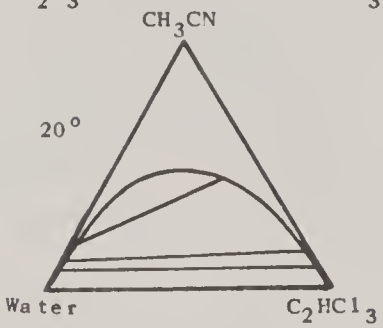
$C_2O_4K_2$ - Potassium Oxalate, $(COOK)_2$ with Aniline.

(II 408) Salting out.

TRICHLOROETHYLENE

C_2HCl_3 - Trichloroethylene - I_2, Iodine (I 666).

C_2HCl_3 - C_2H_3N, Acetonitrile, CH_3CN.



H. R. C. Pratt, Ind. Chemist 23, 658 (1947).

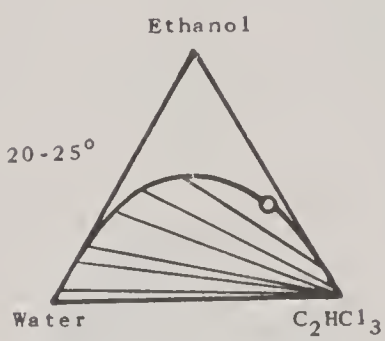
The system is solutropic with a horizontal tie line at 14% acetonitrile.

C_2HCl_3 - Ethanol.

A. P. Colburn and J. C. Philips, Trans. Am. Inst. Chem. Engrs. 40, 333 (1944).

Gms. per 100 gms.

Upper Aqueous Layer			Lower Layer		
Water	Ethanol	C_2HCl_3	Water	Ethanol	C_2HCl_3
90.7	8.8	0.5	0.2	0.6	99.2
79.1	20.1	0.8	0.3	1.3	98.4
72.5	26.5	1.0	0.4	1.8	97.8
58.7	38.3	3.0	0.5	5.3	94.2
49.0	44.2	6.8	0.9	8.7	90.4
27.9	47.0	25.1	3.5	19.1	77.4



W. Reinders and Miss C. H. de Minjer, Rec. trav. chim. 66, 552 (1947). Same system at 20°, 50°, and 67°.

At 20°

Upper Aqueous Layer			Lower Layer		
Water	Ethanol	C_2HCl_3	Water	Ethanol	C_2HCl_3
84.6	15.0	0.4	0.2	0.4	99.4
72.0	27.0	1.0	0.2	1.7	98.1
58.4	39.0	2.6	0.3	5.0	94.7
37.4	48.2	14.4	2.0	14.2	83.8
31.8	48.1	20.1	2.8	17.5	79.7
23.0	45.3	31.7	4.6	23.2	72.2
15.4	39.3	45.3	8.3	30.5	61.2

At 67°

72.9	25.4	1.7	0.5	4.0	95.5
57.7	37.2	5.1	1.3	10.1	88.6
38.0	43.8	18.2	4.1	18.9	77.0
20.7	38.2	41.1	11.1	30.0	58.9

TRICHLOROETHYLENE - Acetone (II 181).

On a weight percentage basis acetone dissolves in greater amount in the aqueous layer up to 20% and in trichloroethylene above that, indicating a solutrope according to H. R. C. Pratt as reported by A. S. Smith (1950).

TRICHLOROETHYLENE - Allyl Alcohol, $CH_2:CHCH_2OH$.

C. H. G. Hands and W. S. Norman, Ind. Chemist 21, 307 (1945). An abstract paper with no numerical data or diagram.

TRICHLOROETHYLENE - See C_4H_8O, Methyl Ethyl Ketone.

TRICHLOROETHYLENE - C_6H_6O, Phenol (II 386).

The system is solutropic.

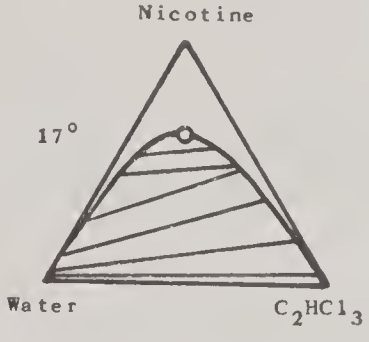
TRICHLOROETHYLENE - $C_{10}H_{14}N_2$, Nicotine.

J. Reilly, D. F. Kelly, and M. O'Connor, J. Chem. Soc., 1941, 275.

Gms. per 100 gms. Solution at 17°

Aqueous Layer			Organic Layer		
Water	Nicotine	C_2HCl_3	Water	Nicotine	C_2HCl_3
99.41	0.49	0.10	0.66	5.02	94.33
96.79	3.09	0.12	0.40	19.46	80.14
90.56	9.28	0.16	1.23	34.63	64.14
77.52	22.08	0.40	2.25	44.29	53.46
56.08	42.33	1.59	2.46	45.59	51.95
42.82	53.34	3.84	6.81	56.64	36.55
21.03	60.33	18.64	16.10	60.00	23.90

This system is solutropic with a horizontal tie line close to the apex of the binodal curve and to the plait point, an unusual relation.

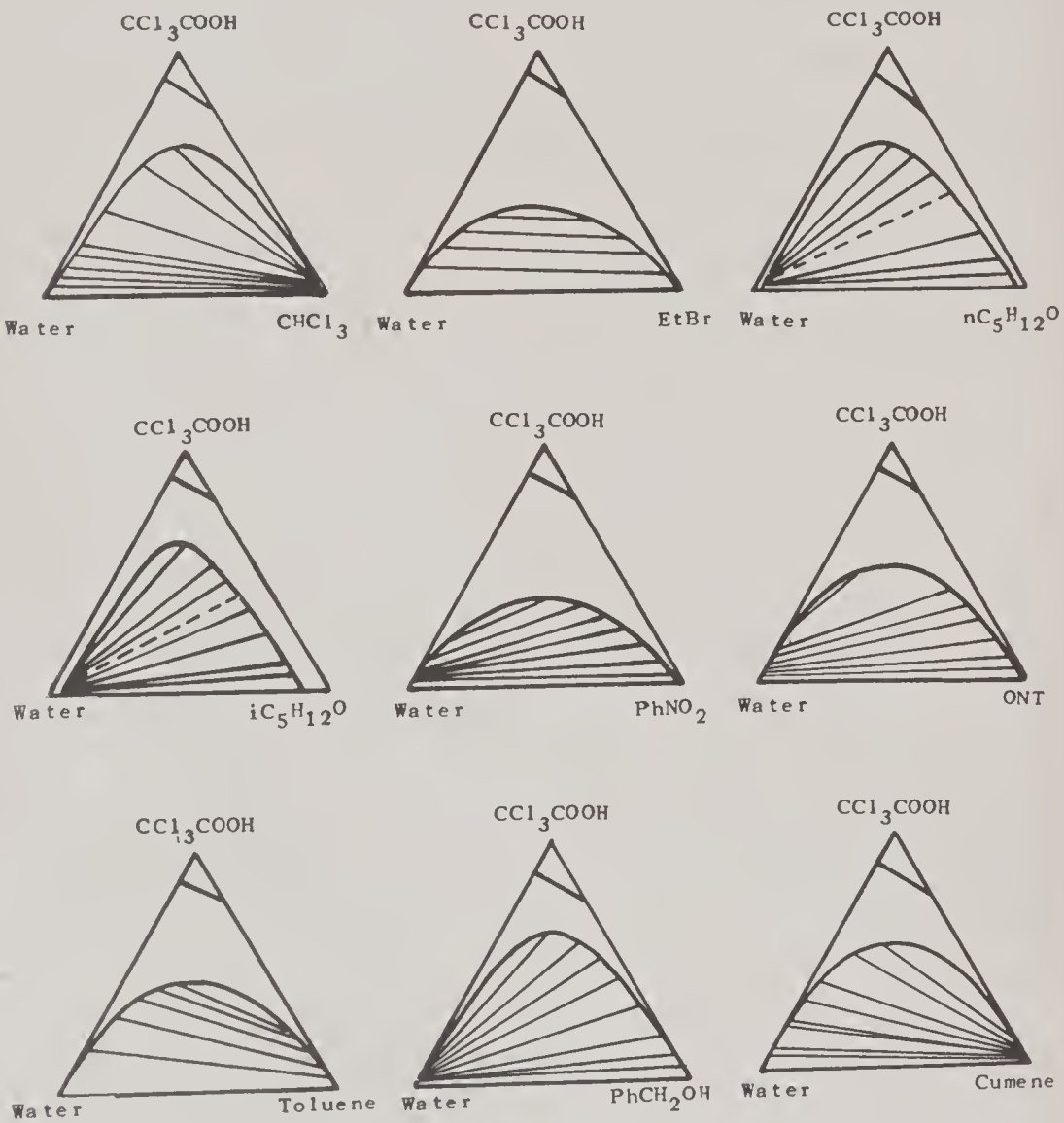


C_2HCl_5 - Pentachloroethane, $CHCl_2CCl_3$.

Distribution between water and pentachloroethane of bromine (I 211), iodine (I 668), acetone (II 181), and phenol (II 386).

$C_2HO_2Cl_3$ - Trichloroacetic Acid, CCl_3COOH. See CCl_4, CH_3I, CS_2.

The data of Kolossowski and Kulikov (II 68-70) at 25° are only distributions, but several of them give evidence of extending nearly to the apices of the curves. Tentatively, the graphs are as follows:



Distribution of Trichloroacetic Acid between water and CCl_4, CS_2, $CHCl_3$, C_6H_6, $C_6H_5NO_2$ (Andreosov, 1928).

TRICHLOROACETIC ACID (cont.)

The short line near the top shows equilibrium with solid trichloroacetic acid. Three of the systems, with ethyl bromide, nitrobenzene, and o-nitrotoluene are solutropic; that is, have horizontal tie lines. Two of the systems, with the amyl alcohols have isopycnics (dashed tie lines) connecting compositions with equal densities. There is a slight discrepancy in the last two items for cumene, which give crossed tie lines (impossible).

CCl_3COOH - Ether

Distribution (II 68).

CCl_3COOH - Pentene or Benzene.

Nernst and Hohmann (1893). Distributions are recalculated to weight percentage of acid in the aqueous layer against those in the hydrocarbon layers (two separate systems).

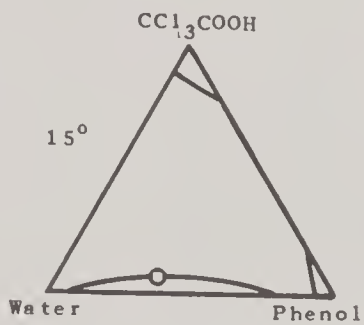
Water	Pentene	Benzene
5.3	0.47	0.275
8.9	1.12	0.70
14	2.46	1.93
16	3.2	2.8
19	4.1	4.3
23	5.4	6.6

CCl_3COOH - Benzene (I 585, II 68).

These give only the solubility of water in benzene solutions of trichloroacetic acid. Other studies of this system are Andreasov (1928), Drucker (1904), Knaus (1923), Nernst and Hohmann (1893).

CCl_3COOH - Phenol, C_6H_5OH. Ust-Kachkinstev (1937).

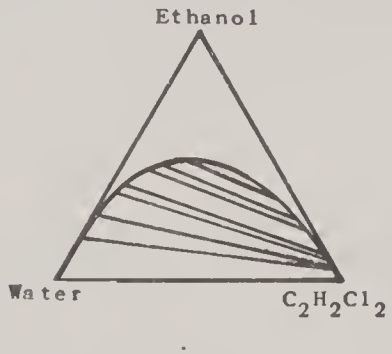
Two corners of this system are "cut off" by lines indicating equilibrium with solid phases. The plait point is at about 6.5% trichloroacetic acid and 35% phenol.



$C_2HO_2Cl_2Na$ - Sodium Dichloroacetate - Phenol. Schryver (1910).

$C_2H_2Cl_2$ - 1, 1 - Dichloroethylene $CH_2:CCl_2$ - Ethanol.

T. K. Skripach and M. I. Temkin, J. Phys. Chem. (U.S.S.R.) 20, 583 (1946); Chem. Abstracts 41, 26.



Water	Ethanol	$CH_2:CCl_2$
96.5	2.9	0.73
75.0	23.7	1.2
61.4	34.4	3.74
56.0[a]	39.0	5.19
40.6	43.1	16.3
31.0	46.0	23.0
18.4	40.8	40.8
11.6	35.9	52.9
5.2	28.3	66.5
1.96	12.9	84.0
0.15	0.5	99.5

(a) The original says "36.0", a typographical error. In some other cases the figures do not add to exactly 100%. Fifteen additional points are given.

The tie lines in the figure are shown in the original but without explicit data.

$C_2H_2Cl_4$ - Tetrachloroethane, $CHCl_2CHCl_2$.

Bromine, I 211; Iodine, I 668.
Acetone, II 181. Othmer, White, and Trueger (1941).

.Gms. per 100 gms. Solution

Upper Layer			Lower Layer		
Water	Acetone	$C_2H_2Cl_4$	Water	Acetone	$C_2H_2Cl_4$
96.7	3.00	0.28	1.1	7.11	91.8
88.3	11.4	0.3	1.7	19.2	79.1
79.1	20.6	0.3	2.0	30.0	68.0
71.8	27.7	0.5	4.1	39.2	56.7
66.25	33.0	0.75	6.1	43.9	50.0
–	–	–	10.4	55.8	33.6
–	–	–	17.4	59.3	23.3
–	–	–	23.7	58.3	18.0
57.6	40.3	2.1	–	–	–
45.3	49.8	5.38	–	–	–

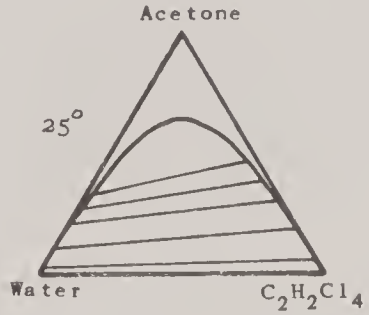
$C_2H_2Cl_4$ - Acetone (cont.).

Correction: In the title of Table VI of Othmer, White, and Trueger's table instead of "Acetic Acid", read "Acetone". The acetone concentrations in the above paper are taken from Table VI, those of the other components being interpolated from their Table IV.

(Fritzsche and Stockton, 1946).

Gms. per 100 gms. Solution

Water	Acetone	$C_2H_2Cl_4$
69.4	29.8	0.8
45.8	49.4	4.8
33.6	55.9	10.5
15.3	60.5	24.2
7.0	56.0	37.0
3.2	45.7	51.1
1.9	36.8	61.3

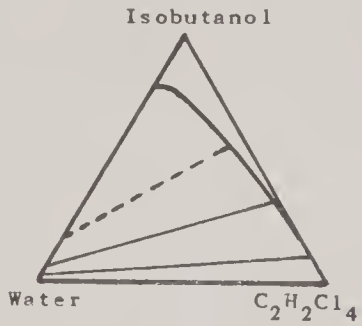


$C_2H_2Cl_4$ - Isobutanol.

Fritzsche and Stockton (1946).

Gms. per 100 gms. Solution

Upper Layer			Lower Layer		
Water	$C_4H_{10}O$	$C_2H_2Cl_4$	Water	$C_4H_{10}O$	$C_2H_2Cl_4$
99.7	0.0	0.3	0.1	0.0	99.9
97.85[a]	1.85[a]	0.3	0.5	9.0	90.5
93.8[a]	6.0[a]	0.2	2.5	31.0	66.5
92.4	7.6	0.0	16.4	83.6	0.0



(a) Computed by compiler from data reported. Twenty other observations on composition of the organic layer are given.

$C_2H_2Cl_4$ - Phenol II 386.

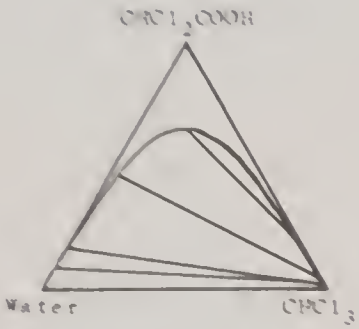
$C_2H_2O_2Cl_4$ - Dichloroacetic Acid, $CHCl_2COOH$. See CCl_4.

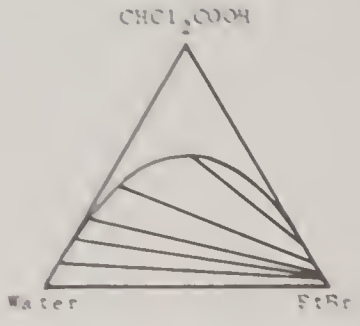
Chloroform, Ethyl Bromide, Toluene, Nitrobenzene, and o-Nitrotoluene (II 78). Only distributions are given but some of these give evidence of extending to the peaks of the curves making inference of approximate diagrams possible, as follows, all at 25°:

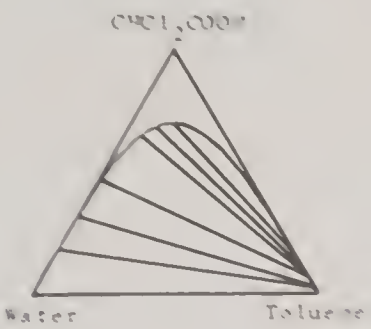
C_2H_2

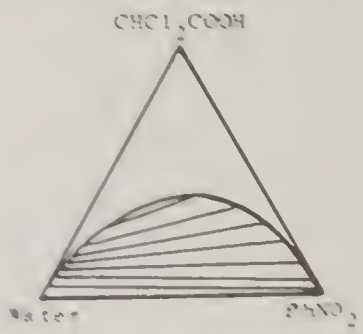
TERNARY AQUEOUS SYSTEMS

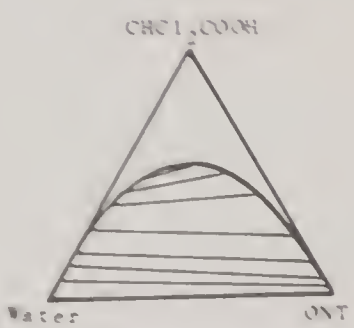
DICHLOROACETIC ACID











The last two systems are solutropic with horizontal tie lines at about 15% and 30% acid respectively.

$CHCl_2COOH$ - Ether II 78.

Correction: In the table at the top of II 78, the column heading "$CHCl_3$ layer" should read "Ether layer".

$CHCl_2COOH$ - Benzene I 585. II 77.

The data give the solubility of water in benzene solutions of dichloroacetic acid. The title in Vol. I is preferable. Other references without numerical data are Georgevics (1015) and Knaus (1023). The latter studied xylene also.

$CHCL_2COOH$ - Olive Oil (II 79) Distribution

$C_2H_2O_2ClNa$ - Sodium Chloroacetate $CH_2ClCOONa$.

Phenol, Schryver (1910).

$C_2H_2O_4$, Oxalic Acid, $(COOH)_2$.

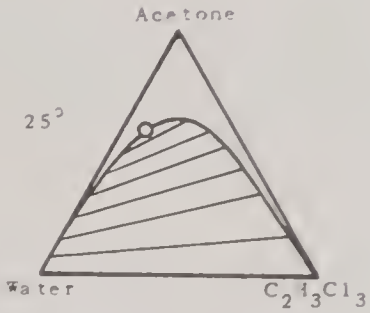
Ether (II 83, 84).

n-Amyl Alcohol (II 83); Asselin and Comings (1950).

Phenol, Ust-Kachkintsev (1937). Isotherms were observed at 50°, 55°, 60°, 65°, 66°, and 68°. These form closed curves with a ternary critical solution point at 68°.

$C_2H_3Cl_3$, 1,1,2-Trichloroethane, $CHCl_2CH_2Cl$.

Acetone, R. E. Treybal, L. D. Weber, and J. F. Daley, Ind. Eng. Chem. 38, 817 (1946).



Gms. per 100 gms. Solution

Upper Layer			Lower Layer		
Water	Acetone	$C_2H_3Cl_3$	Water	Acetone	$C_2H_3Cl_3$
93.57	5.96	0.52	0.32	8.75	90.93
85.35	13.97	0.68	0.00	20.78	78.32
80.16	19.05	0.79	1.33	27.66	71.01
71.33	27.63	1.04	2.40	39.39	58.21
57.00	40.90	2.10	6.05	53.95	40.00
41.70	51.78	6.52	13.40	60.34	26.26
27.4	58.0	14.6	Plait Point		

Vapor liquid data also are given.

$C_2H_3Cl_3$. See also C_4H_8O, Methyl Ethyl Ketone.

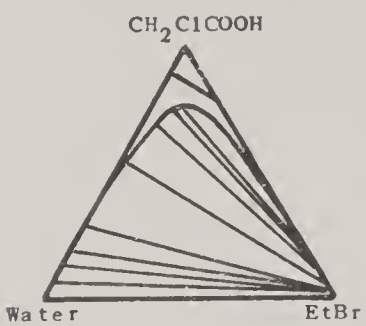
C_2H_3N Acetonitrile, CH_3CN. See C_2HCl_3, Trichloroethylene, p. 874

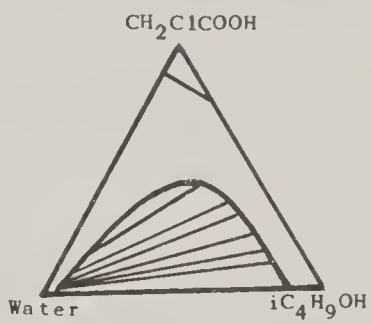
$C_2H_3O_2Br$, Bromoacetic Acid, $CH_2BrCOOH$ (II 86).

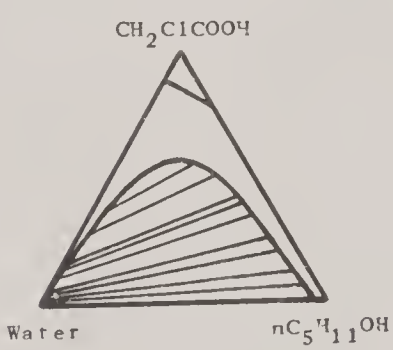
Distribution between water and chloroform, ether, benzene, toluene, xylene, or olive oil.

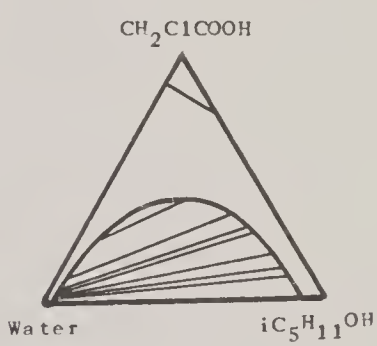
$C_2H_3O_2Cl$, Chloroacetic Acid, $CH_2ClCOOH$ (I 585) (II 88-91).

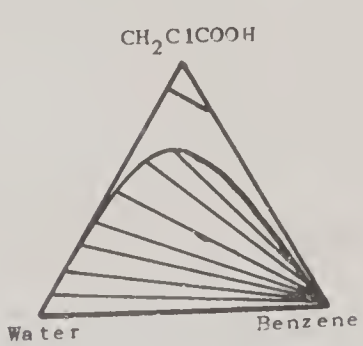
See CCl_4, CS_2, $CHBr_3$, $CHCl_3$, CH_3I. Distributions are given between water and either olive oil or eight other solvents. Those in the latter cases extend to high concentrations of acid, some of them to the apices of the curves so that approximate diagrams can be inferred from the data as follows, all at 25°.

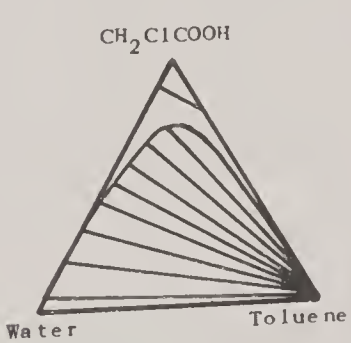






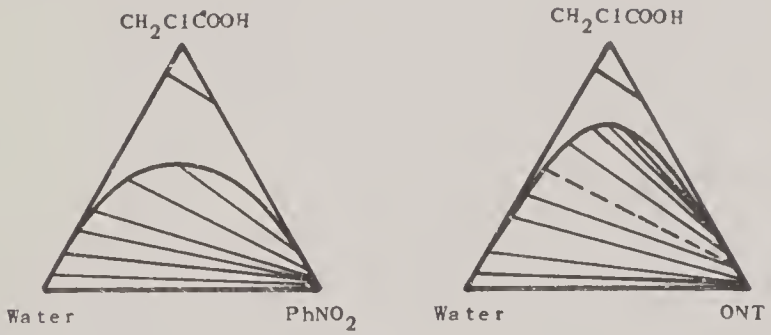






CHLOROACETIC ACID

$CH_2ClCOOH$ (cont.)



The short line near the top corner of each graph shows the composition of liquid in equilibrium with solid acid. The acid dissolves by preference in the aqueous layer except in the cases of the alcohols. In the last graph, with o-nitrotoluene, the dashed line indicates the approximate position of an isopycnic, a tie line connecting compositions with equal density in equilibrium. There may be isopycnics in the nitrobenzene and the isobutanol systems (near the tops); but probably not in the other systems.

Corrections: In the top table on p. II 89 the headings "H_2O Layer" and "C_6H_6 Layer" or "$C_6H_5CH_3$ Layer" should be interchanged (all four times). In the next table (Schreiner) the concentrations are in mols. per liter. In the nitrobenzene table (II 90) the formula should be "$C_6H_5NO_2$". In the toluene table the acid should be $CH_2ClCOOH$. In the isoamyl alcohol table (II 91) the formula should be $C_5H_{11}OH$. In the o-nitrotoluene table the last four items should be rearranged in ascending order of concentration in the $C_6H_4CH_3NO_2$ layer, so that those in the aqueous layer are 8.128, 8.601, 8.342, 7.991; i.e. these points rise to the apex and fall again. The title of the top table on p. II 88 may be misleading, since only the solubilities of water in benzene solutions of chloroacetic acid are given (Cf. I 585).

$CH_2ClCOOH$,

Distribution of chloroacetic acid between water and xylene (Knaus, 1923).

$CH_2ClCOOH$ - Di-n-butyl Ether (II 92).

$C_2H_3O_2I$ - Iodoacetic Acid, CH_2ICOOH (II 94).

Distributions are given between water and chloroform, benzene, or olive oil.

$C_2H_3O_2Br_3$ - Bromal Hydrate, $CBr_3CH(OH)_2$.

Olive Oil (II 87).

$C_2H_3O_2Cl_3$ - Chloral Hydrate, $CCl_3CH(OH)_2$.

Ether, benzene, toluene, or olive oil (II 93).

$C_2H_3O_2K$, Potassium Acetate, CH_3COOK. (II 408).

The salting out effect on aniline is shown.

$C_2H_3O_2Na$ - Sodium Acetate, CH_3COONa.

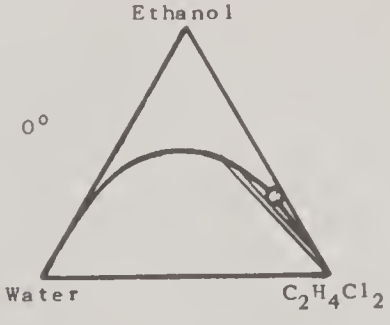
tert Butanol (I 1169). The plait point is at 57.3% water, 38.0% tert-butanol, 4.7% $NaOCOCH_3$. Salting out of ether by sodium acetate (II 275, 276); of isoamyl alcohol (II 315).

The ternary diagram for sodium acetate-phenol is referred to on (I 1169).

$C_2H_4Br_2$ - Ethylene Bromide. Iodine (I 666).

$C_2H_4Cl_2$ - Ethylene Chloride. CH_2ClCH_2Cl.

Ethanol (II 98). Bonner's data at 0° are recalculated to gms. per 100 gms. solution.



Water	Ethanol	$C_2H_4Cl_2$	
64.7	34.0	1.3	
49.1	45.7	5.2	
41.0	48.7	10.3	
29.9	50.2	19.9	
20.7	48.2	31.1	
16.7	44.4	38.9	
12.5	40.1	47.4	
8.2	31.5	60.3	P.P.
7.0	29.6	63.4	
2.4	16.0	81.6	

Tie lines, % ethanol in:

Aqueous Layer	$C_2H_4Cl_2$
46	10
41	16

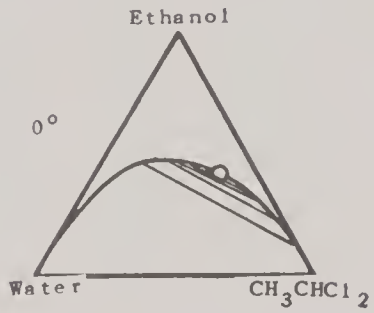
ETHYLENE CHLORIDE - Diethyl Amine $(C_2H_5)_2NH$. (II 279).

Olive oil, (Int. Crit. Tables III 423).

$C_2H_4Cl_2$ - Ethylidine Chloride, CH_3CHCl_2.

Ethanol (II 98). Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	CH_3CHCl_2	
61.5	36.6	1.9	
50.8	44.1	5.6	
43.0	46.7	10.8	
37.2	46.8	16.0	
30.3	46.2	23.5	
22.6	43.5	33.9	
19.2	41.8	39.0	Plait Pt.
12.3	36.9	50.8	
7.0	30.1	62.9	
1.2	18.4	80.4	



Tie lines

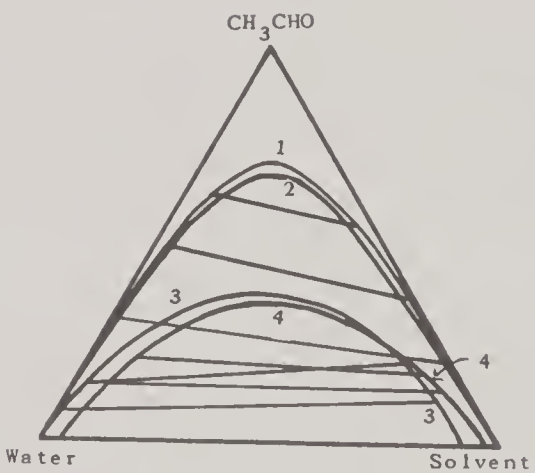
% ethanol in:	
Aq. layer	CH_3CHCl_2 layer
46.7	15
46.8	25
46.4	32
44.5	37

C_2H_4O - Acetaldehyde, CH_3CHO.

Systems with toluene, benzene, n-amyl alcohol, and furfural. Othmer and Tobias (1942).

Gms. per 100 gms. Solution (water by difference)

CH_3CHO	Toluene
0	0.05
49	1
55.8	2
60	5
69.1	10.8
70.9	16.7
68.2	24.7
55.2	42
40.3	58.3
20	79.8
0	99.96



1. Toluene (17°)
2. Benzene (18°)
3. n-Amyl alcohol (18°)
4. Furfural (16°)

(Benzene tie lines, which are nearly horizontal, not shown).

ACETALDEHYDE (cont.).

CH_3CHO	Benzene	CH_3CHO	$C_5H_{11}OH$	CH_3CHO	Furfural
0	0.17	0	2.6	5.2	7.0
26.5	2	10.2	4.2	20.2	9.7
44.0	3.4	21.7	6.0	33.3	10.7
59.0	5.0	29.4	9.9	35.1	30.8
66.0	19.1	37.3	16.7	32.2	54.0
68.4	20.1	40.6	28.2	20.1	72.9
58.2	39.1	34.8	47.5	10.8	84.1
45.0	53.8	24.4	62.2	2.6	93.2
25.0	74.4	18.0	72.9		
10.0	89.8	4.8	84.2		
0	99.95				

Distribution Data, Weight % Acetaldehyde in:

Water Layer	Toluene Layer	Water Layer	Benzene Layer
62.2	54.7	17.6	19.0
48.7	35.3	13.2	14.2
30.3	19.8	9.1	10.6
22.2	13.8	4.2	4.7
17.0	9.0		
9.0	4.3		

	n-Amyl Alcohol Layer		Furfural Layer
14.8	23.3	24.2	21.2
8.4	12	20.3	18.3
		14.8	14.3

ACETALDEHYDE - $C_4H_6O_2$ - Vinyl Acetate. $CH_3COOCH{:}CH_2$.

H. R. C. Pratt and S. T. Glover, Trans. Inst. Chem. Engrs. (London), 24, 54 (1946). The system is solutropic.

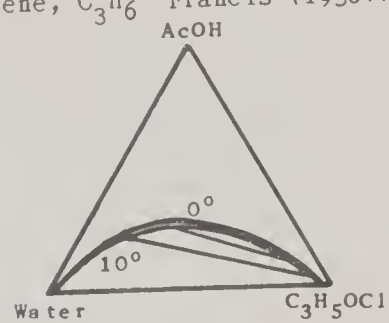
ACETALDEHYDE - $C_6H_{12}O_3$, Paraldehyde $(CH_3CHO)_3$ (II 441).

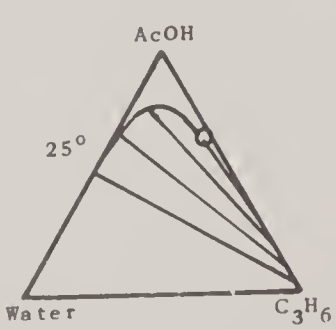
C_2H_4OS - Thioacetic Acid, CH_3COSH. Ether (II 118).

ACETIC ACID - $C_2H_4O_2$ - Methyl Formate. See Ethanol

ACETIC ACID $C_2H_4O_2$, CH_3COOH. See CCl_4, CS_2, $CHBr_3$, $CHCl_3$, C_3H_5OCl, Epichlorohydrin, OCH_2CHCH_2Cl (II 102, 103, 108).

Propylene, C_3H_6 Francis (1950).





ACETIC ACID - Propylene (cont.).

Gms. per 100 gms. Solution at 25°

Lower Layer			Upper Layer		
Water	AcOH	C_3H_6	Water	AcOH	C_3H_6
51	48	1	0	6	94
36	61	3	0	8	92
18	73	9	0	24	76
4	62	34	Plait Point		

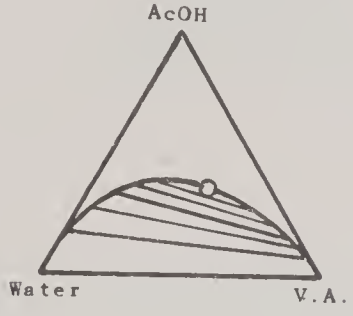
ACETIC ACID - $C_4H_6O_2$, Vinyl Acetate, $CH_3COOCH:CH_2$ (V.A).

J. C. Smith, J. Phys. Chem. 45, 1301 (1941).

Gms. per 100 gms. Solution at 25°

Aqueous Layer			Organic Layer		
Water	AcOH	V.A.	Water	AcOH	V.A.
97.5	0.0	2.5	0.1	0.0	99.9
90.6	6.18	3.2	0.8	2	97.2
81.9	13.83	4.3	2.4	6	91.6
70.15	23.05	6.8	4.5	12	83.5
59.75	29.95	10.3	6.6	17.8	75.6
53.2	33.60	13.2	10.4	22.8	66.8
40.6	35.9	23.5	19.0	30.0	51.0

Only part of the above table is given. The remainder was taken from the graph.

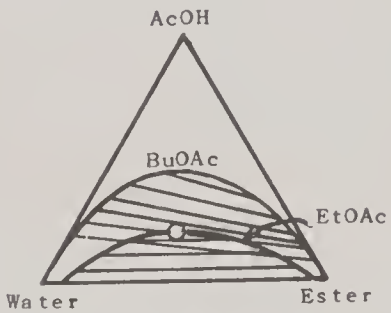


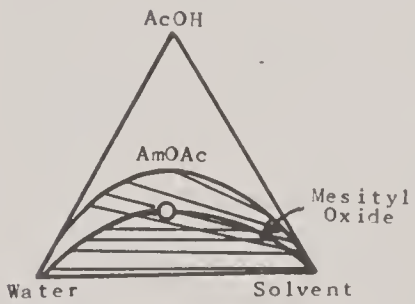
ACETIC ACID - C_4H_8O, 2-Butanone or Methyl Ethyl Ketone (II 106).

ACETIC ACID - Esters, etc.

H. Guinot, Chimie & Industrie, 21, 245 (1929). Partition coefficients of acetic acid between water and organic liquids at "ordinary temperature."

Concentration in Aqueous Layer gms. per liter	Partition Coefficients $\frac{\text{Conc. } H_2O}{\text{Conc. Org. Solvent}}$			
	Ethyl Acetate	Butyl Acetate	Amyl Acetate	Mesityl Oxide
0	1.22	2.94	3.80	1.30
50	1.08	2.70	3.8	1.12
100	1.00	2.38	3.3	1.05
150	0.99	2.18	3.0	1.02
200	1.00 (195)	2.00	2.8	1.01
250		1.85	2.6	1.00(240)
300		1.72	2.4	
350		1.56	2.2	
400		1.45	2.1	
440		1.27	1.85 (435)	





The graphs are only approximate since the concentrations in the table are on a volume basis and no densities are given. Additional distributions of acetic acid between water and ethyl acetate are given by Waentig and Pescheck (1919).

ACETIC ACID - $C_4H_{10}O$, n-Butanol (II 106).

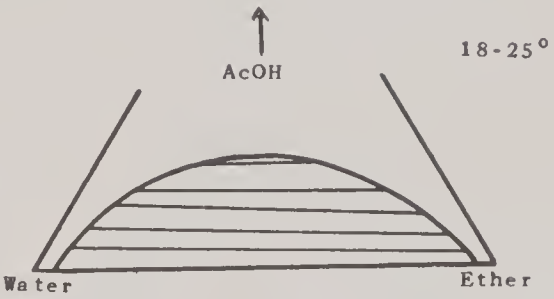
See also Leonard (in table below) and Orton and Jones (1919).

sec-Butanol (II 106).

Isobutanol - See Leonard, Peterson, and Johnson (1948) p. 900.

ACETIC ACID - Ether (II 102, 110, 114).

The last two items in the top table on II 102 do not indicate points on the binodal curve. They merely mean that 70% acetic acid is miscible with ether; and water is miscible with an ether mixture containing 60% acetic acid.



C. J. Major and O. J. Swenson, Ind. Eng. Chem. 38, 834 (1946).

Gms. per 100 gms. Solution

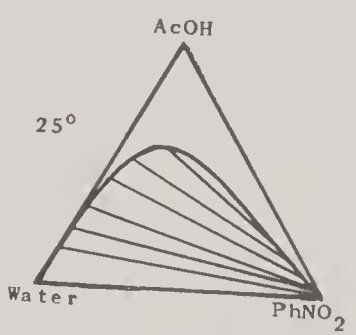
Lower Layer			Upper Layer		
Water	Acid	Ether	Water	Acid	Ether
87.5	5.9	6.8	2.8	4.2	93.3
81.5	11.1	7.4	4.5	8.9	86.6
75.8	16.0	8.0	6.8	14.3	78.9
69.6	20.6	9.8	9.7	19.8	70.5
62.0	25.3	12.7			
			14.6	25.4	60.0
52.9	29.3	17.8	21.6	29.6	49.0

This system is solutropic with a horizontal tie line between 20 and 30% acetic acid. Vlček (1935) studied the system.

ACETIC ACID - $C_6H_5O_2N$, Nitrobenzene (II 111).

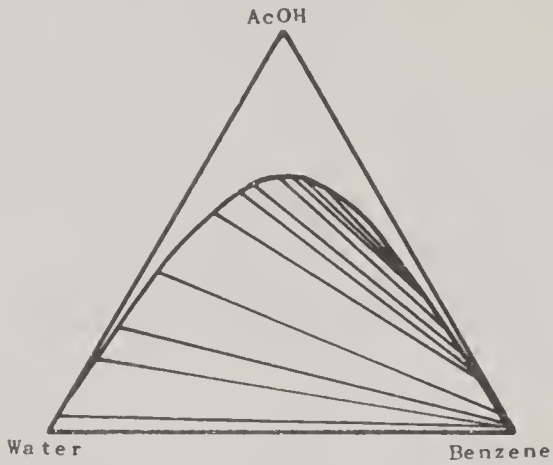
(A. A. Vernon and B. Brown, J. Chem. Ed., 14, 143 (1937)). Data in volume per cent are recalculated to gms. per 100 gms. solution.

Water	AcOH	Nitrobenzene
67.0	31.7	1.3
57.3	40.4	2.3
45.0	49.6	5.4
37.6	53.4	9.0
27.1	56.7	16.2
20.5	34.9	24.6
14.8	49.7	35.5
11.5	42.3	46.2
5.4	29.5	65.1



Correction: In the graph of Vernon and Brown the components H_2O and $C_6H_5NO_2$ are interchanged. The tie lines of this graph (not given by Vernon and Brown) are taken from the data of II 111. Additional data on this system are given by Orton and Jones (1919).

ACETIC ACID - C_6H_6, Benzene (I 585, II 106-9).



Data of Leikola (1940) at 20-21° recalculated to gms. per 100 gms. solution.

Water	Acid	Benzene
28.1	65.5	6.5
14.5	65.8	19.7
7.6	54.4	38.0
1.8	32.7	65.5

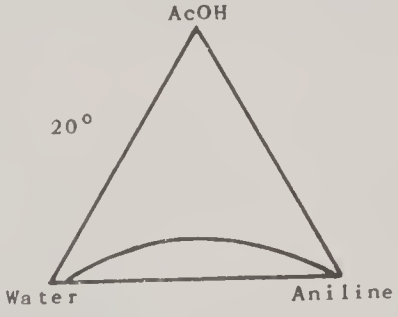
Additional data on this system are reported by J. W. Belton, Trans. Faraday Soc., 35, 1354 (1939); by M. Freed, Trans. Roy. Soc. Canada III, 27, 179 (1933); by Illinsky and Ivanov (1938); by T. Sasaki, Bull. Chem. Soc. Japan 14, 3(1939); Chem. Abstracts 33, 3320; and by Waentig and Pescheck (1919); and the system is used for illustration and calculation by Othmer and Tobias (1942c), and by Tarasenkov and coworkers in three papers (1936-9).

ACETIC ACID - C_6H_6O, Phenol. Ust. Kechintsev (1937).

The 15° isotherm is a simple graph with complete homogenization of phenol and water with moderate concentrations of acetic acid. However, the phenol corner is "cut off" by a curve showing concentrations in equilibrium with solid phenol.

ACETIC ACID - $C_6H_{10}O$. Mesityl Oxide. See acetic acid-ethyl acetate.

ACETIC ACID - C_6H_7N, Aniline (II 104-5, 412-3).



ACETIC ACID - Several solvents.

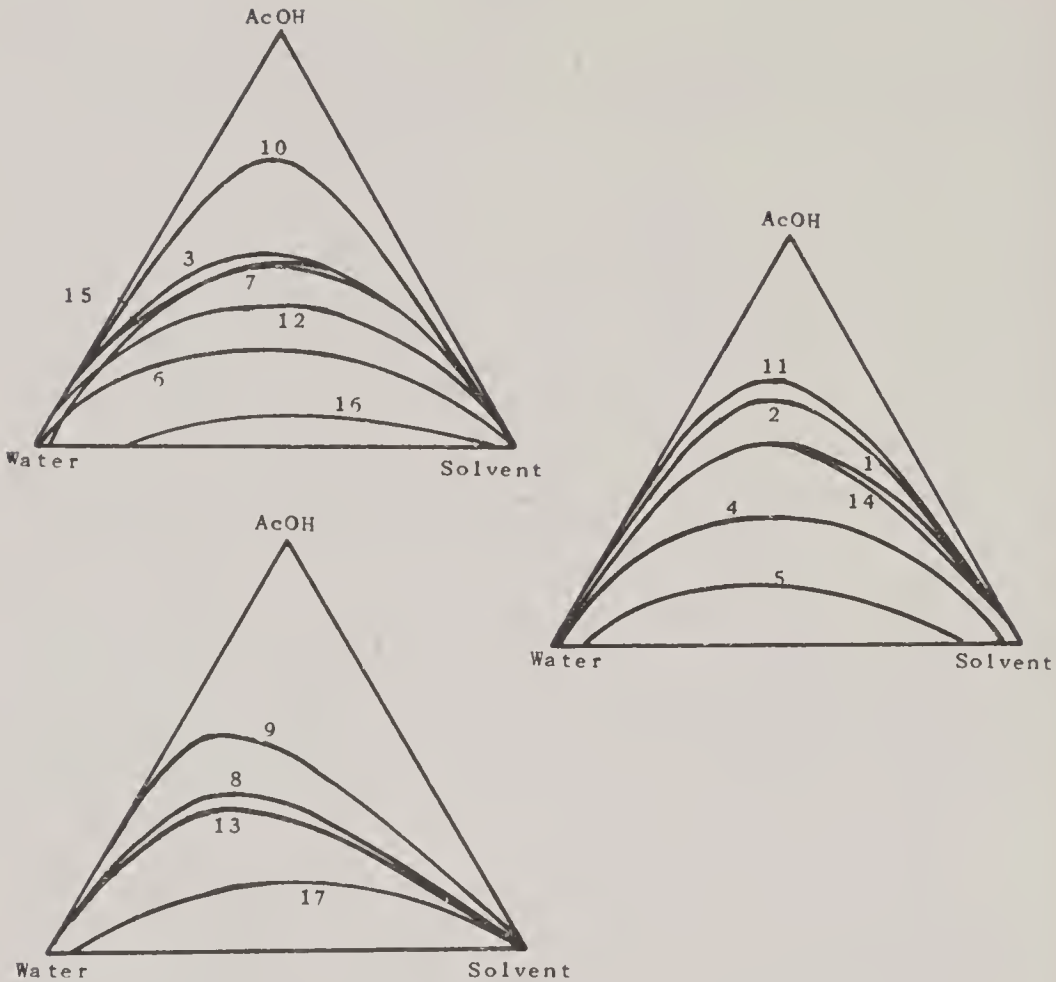
Othmer, White and Trueger (1941). Concentrations in gms. per 100 gms. solution at 22-5° at the apex of the curve (maximum concentration of acetic acid).

No.	Formula	Name	Water	AcOH	Solvent
16	$C_6H_{10}O_4$	Ethylene diacetate	42.9	7.3	49.8
12[a]	$C_6H_{12}O$	Methyl isobutyl ketone	48.6	34.2	17.2
8	$C_6H_{12}O_2$	Butyl acetate	54.42	38.2	16.38
1[a]	$C_6H_{14}O$	Isopropyl ether	34.9	48.4	16.7
4[a]	$C_7H_{12}O$	Methyl cyclohexanone	32.6	31.9	35.5
14[a]	$C_7H_{14}O_2$	Isoamyl acetate	41.1	47.8	11.1
5	$C_7H_{14}O_3$	Butyl lactate	64.87	15.25	19.88
15[a]	$C_7H_{16}O$	Diisopropyl carbinol	39.3	47.2	13.5
3[a]	$C_8H_{14}O_2$	Cyclohexyl ("Hexalin") acetate	40.0	47.5	12.43
10[a]	$C_8H_{18}O$	n-Butyl ether	19.5	69.8	10.7
13[a,b]	$C_9H_{14}O$	Isophoron	41.5	34.7	23.8
17	$C_9H_{14}O_6$	Triacetin	45.4	17.2	37.4
2[a]	$C_9H_{18}O$	Diisobutyl ketone	30.7	60.8	8.5
9[a]	$C_{10}H_{16}O$	Fenchone	43.36	54.22	2.42[d]
11[a]	$C_{10}H_{20}O_2$	Octyl acetate	27.0	65.3	7.7
7	$C_{10}H_{20}O_2$	Butyl diacetone ether	40.4	44.1[c]	15.43
6	$C_{10}H_{20}O_4$	Butyl carbitol acetate	52.26	24.54	23.2

a) Distributions also are given.
b) System is solutropic.
c) A concentration 63.6% acetic acid, in the original paper is evidently a typographical error for 43.6.
d) The extreme lack of symmetry indicated by this low concentration of solvent is not supported by the authors' graph.

Complete composition data are given for each binodal curve. Some distributions (tie lines) also are given, but not plait points although their approximate positions can be inferred from the tie lines. "Acetic Acid" in the title of Table VI is evidently a typographical error for "Acetone".

ACETIC ACID



Acetic Acid - $C_6H_{14}O$, Isopropyl Ether

G. C. Brown, "Unit Operations." J. Wiley and Sons, New York (1950) p. 581.

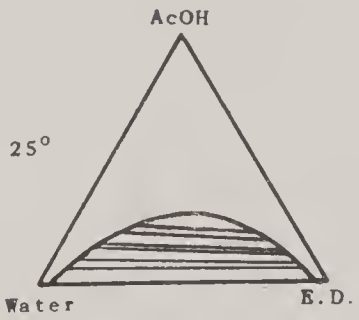
Gms. per 100 gms. Solution at 20°

Lower Layer			Upper Layer		
Water	AcOH	$C_6H_{14}O$	Water	AcOH	$C_6H_{14}O$
99.0	0	1.0	0.6	0	99.4
93.1	5	1.9	1.0	1.4	97.6
87.85	10	2.15	1.4	3.6	95.0
77.20	20	2.80	2.2	7.0	90.8
66.5	30	3.5	4.6	11.5	83.9
54.2	40	5.8	9.7	25.9	65.4
43.4	45	11.6	11.8	31.9	56.3
36.9	46.5	16.6	15.1	36.2	48.7
23.9	44.8	31.3	Plait Point		

ACETIC ACID - $C_6H_{10}O_4$, Ethylidene Diacetate $CH_3CH(OCOCH_3)_2$.

J. C. Smith, J. Phys. Chem. 46, 229 (1942).

Water	AcOH	ED
95.0	0.0	5.0
78.7	13.4	7.9
65.7	20.6	13.7
55.8	23.4	20.8
40.4	24.2	35.4
26.3	22.9	50.8
18.2	20.2	61.6
10.7	14.3	75.0.
5.0	0.0	95.0



Tie lines. Wt. percentage Acetic Acid in:

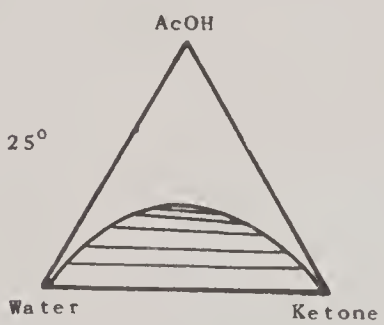
Aqueous Layer	Organic Layer
4.0	3.4
7.6	5.7
11.5	9.5
15.3	12.5
18.1	14.5
20.9	17.7
23.1	21.0

ACETIC ACID - $C_6H_{12}O$, Methyl Isobutyl Ketone, $CH_3COCH_2CH(CH_3)_2$.

Sherwood, Evans, and Longcor (1939).

Water	AcOH	Ketone
98.45	0	1.55
76.8	19.5	3.7
57.5	32.0	10.5
39.6	34.4	26.0
19.2	29.2	51.6
6.5	11.9	81.6
2.12	0	97.9

Rose (1940) presented the same data in slightly different form as a student problem.



Tie lines. Wt. percentage Acetic Acid in:

Lower Layer	Upper Layer
2.85	1.87
11.7	8.9
20.5	17.3
26.2	24.6
32.8	30.8
34.6	33.6

ACETIC ACID - Methyl Isobutyl Ketone (cont.).

Brinsmade and Bliss (1943) give distribution as follows:

Wt. Percentage Acetic Acid at 25° in:		Wt. Percentage Acetic Acid at 44.3° in:	
Lower Layer	Upper Layer	Lower Layer	Upper Layer
1.35	0.92	1.36	0.92
5.0	3.67	5.05	3.56
9.54	7.35	9.6	7.2

Scheibel (1948) presented a graph similar to that shown. Scheibel and Karr (1950) gave the following distribution data at 28°:

Weight Percentage Acetic Acid in:

Lower Layer	Upper Layer	Lower Layer	Upper Layer
0.942	0.578	11.40	8.50
2.89	1.82	16.30	12.97
4.39	2.83	19.88	16.48
8.73	6.15	22.4	19.13

ACETIC ACID - $C_6H_{12}O_2$, Butyl Acetate. See Acetic acid-ethyl acetate.

ACETIC ACID - $C_6H_{12}O_2$, Caproic Acid, $CH_3(CH_2)_4COOH$ and 2-Ethylbutyric Acid $CH_3CH_2CH(C_2H_5)COOH$ and $C_8H_{16}O_2$, 2-Ethylhexoic Acid.

D. F. Othmer and J. Serrano, Jr. Ind. Eng. Chem. 41, 1036 (1949).

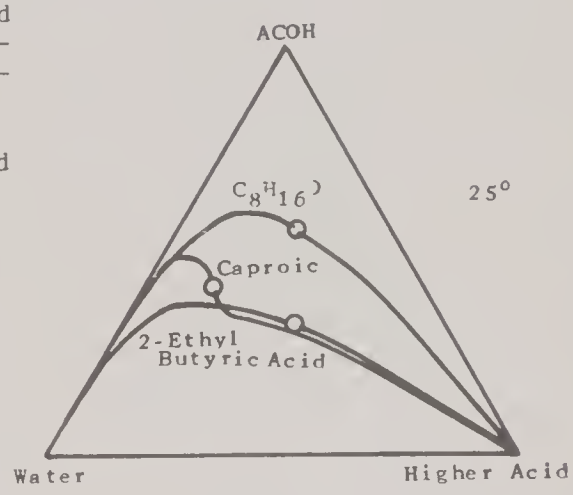
Gms. per 100 gms. Solution at 25°

AcOH	Caproic Acid	AcOH	2-Ethylbutyric Acid	AcOH	2-Ethylhexoic Acid
0	1.1	0	0.25	0	0.15
45.0	2.5	25.6	3.0	47.5	2.0
48.0	5.0	34.5	4.6	55.5	6.5
46.8	8.2	35.9	11.6	57.0	12.0
43.8	11.3 P.P.	36.5	12.5	53.5	25.0 P.P.
37.0	20.0	34.6	20.0	49.0	34.0
30.5	33.0	30.8	34.0 P.P.	40.0	48.8
22.0	58.0	25.8	48.0	21.0	75.0
12.2	78.0	22.8	62.8	10.5	87.2
0.0	94.5	10.0	96.3	0	98.8

The percentages of higher acids are interpolated.

ACETIC ACID - Higher fatty acids (cont.).

The "hump" on the curve for caproic acid is unusual. Such a hump would result from the presence in the caproic acid of an impurity less compatible with water such as butyl caproate. If present, this would not have been removed by the method of purification used, fractional distillation, because of closeness in boiling point. Another sample of caproic acid, purified by crystallization in the compiler's laboratory gave a normal binodal curve which was practically coincident with that published for its isomer, 2-ethylbutyric acid. Distribution data are given in Othmer and Serrano's paper for all three systems as follows:



Weight Percentage Acetic Acid in:

Water	Caproic Acid	Water	2-Ethylbutyric Acid	Water	2-Ethylhexoic Acid
7.45	2.6	7.8	2.6	7.0	2.0
12.8	5.3	12.8	5.7	15.0	4.0
24.0	11.4	23.3	11.8	25.6	7.9
32.0	17.6	32.4	15.6	34.0	11.2
38.8	25.6	35.8	22.0	46.0	17.6
44.2	35.6	32.7	26.3	52.7	25.6
				56.0	37.0

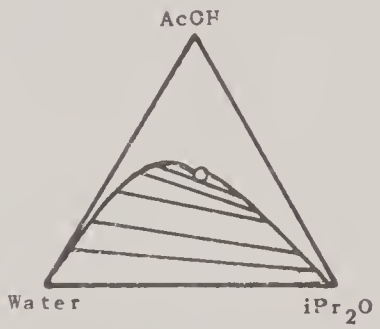
In another table are presented specific gravities for conjugate phases. The acetic acid concentrations there given seem to indicate solutropes in both of the C_6 acid systems; but they are inconsistent with the above quoted distribution data.

The position of the plait point reported for caproic acid, which is on a concave portion of the curve, is theoretically unsound, as explained in the preface.

ACETIC ACID - $C_6H_{14}O$, Isopropyl Ether, iPr_2O. (II 112). Rose (1940a)

Gms. per 100 gms. Solution at 20°

Lower Layer			Upper Layer		
Water	AcOH	iPr_2O	Water	AcOH	iPr_2O
98.1	0.69	1.2	0.5	0.18	99.3
97.1	1.41	1.5	0.7	0.37	98.9
95.5	2.89	1.6	0.8	0.79	98.4
91.7	6.42	1.9	1.0	1.93	97.1
84.4	13.3	2.3	1.9	4.82	93.3
71.1	25.5	3.4	3.9	11.4	84.7
58.9	36.7	4.4	6.9	21.6	71.5
45.1	44.3	10.6	10.8	31.1	58.1
37.1	46.4	16.5	15.1	36.2	48.7



J. C. Elgin and F. M. Browning, Trans. Am. Inst. Chem. Engrs. 31, 666 (1935) gave distributions which are recalculated as follows Weight percentage acetic acid in:

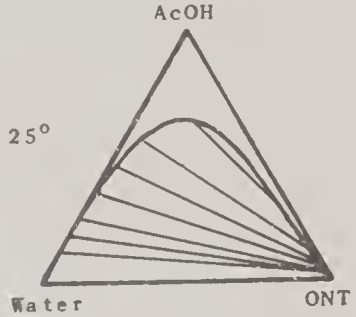
Aqueous Layer	Ether Layer
1.46	0.37
4.15	1.11
7.7	2.2
14.1	4.6
18.6	6.5

See also Brown, 1950 p. 892

ACETIC ACID - C_7H_6O, Benzaldehyde, C_6H_5CHO.

Distribution (Int. Critical Tables III 424).

ACETIC ACID - $C_7H_7NO_2$, o-Nitrotoluene, $CH_3C_6H_4NO_2$. (II 111).

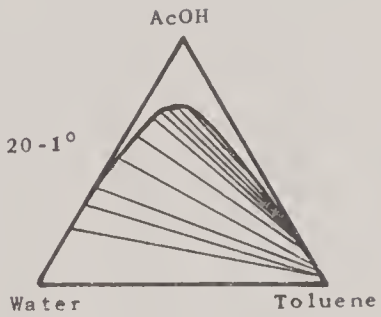


Only distribution is given, but since the concentration in the aqueous layer extends beyond the apex, the whole curve can be plotted approximately.

ACETIC ACID - C_7H_8, Toluene (II 106, 111-2).

Leikola's data at 20-1°, recalculated to gms. per 100 gms. solution.

Water	AcOH	Toluene
22.1	70.8	7.1
11.6	68.0	20.4
4.5	56.3	39.2
1.6	32.8	55.6



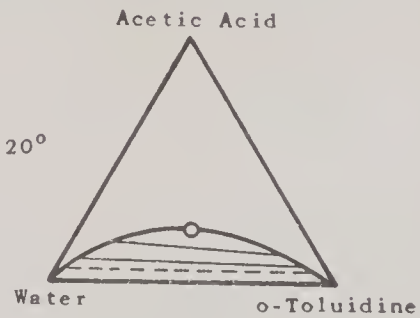
In the tables of results of Herz and co-workers on pages II 88, 106, 112 the two pairs of columns are not horizontally interrelated. That is in the toluene table (II 106), for example, 1.0 G.M. is 60 gms. not 50 gms.

In the table at the top of II 112 the last item, 12.5 gm. equiv. in each layer is not the plait point, which is lower on the toluene side, about 9 gm. equiv. per liter.

Additional data are given by Orton and Jones (1919) and by Waentig and Pescheck (1919).

ACETIC ACID - C_7H_9N, o-Toluidine $CH_3C_6H_4NH_2$ (II 555-7).

Since the observed temperatures, 0° and 20° are below that of the binary isopycnic of water and o-toluidine, 24.5°, according to Mondain-Monval and Quiquarez (1940), the toluidine layer is at the bottom in absence of acetic acid. The preferential solution of the latter in the aqueous layer causes an inversion, so that there is an isopycnic (dashed line).

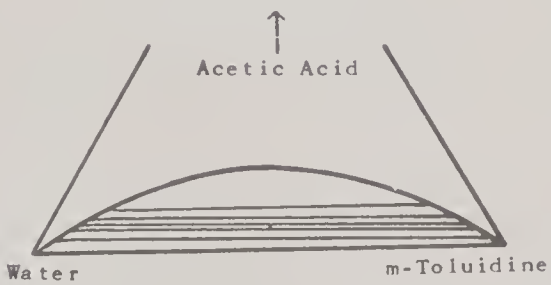


ACETIC ACID - C_7H_9N, m-Toluidine

Angelescu and Cristodulo (1941-2).

Gms. per 100 gms. Solution

At 0°			At 20°		
Water	AcOH	Toluidine	Water	AcOH	Toluidine
98.83	0.0	1.17	98.81	0.0	1.19
84.48	7.34	8.18	87.38	6.28	6.34
65.04	14.41	20.55	78.90	11.36	9.74
54.08	15.69	30.23	69.39	15.18	15.43
44.83	16.35	38.82	59.33	17.09	23.58
34.38	17.06	48.56	49.76	17.95	32.29
24.23	16.36	59.41	39.43	18.50	42.07
14.06	13.06	72.88	30.66	18.38	50.96
3.59	3.37	93.04	22.12	17.25	60.63
2.67	0.0	97.33	10.96	12.31	76.73
			5.64	6.97	87.39
			2.92	0.0	97.08



Distribution.

Wt. % Acetic Acid at 20° in:

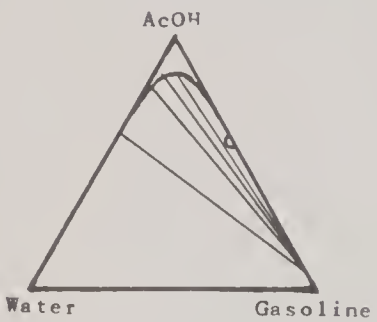
Aqueous Layer	Toluidine Layer
1.14	0.85
2.99	1.91
5.08	3.67
6.32	5.04
8.97	8.09
10.76	10.70

From the trend in distribution the system is probably solutropic having a reversal in slope of tie lines. At 0° the system also has an isopycnic as in the case of o-toluidine; but not at 20°, because the binary isopycnic is at about 7°. The system is also unusual in having greater solubility at 0° than at 20°, so that mixtures with uniform acid concentration, about 18%, have closed curves on temperature concentration graphs. Several such curves are given in the original.

ACETIC ACID - Gasoline.

(Francis, 1950, p. 247) Gms. per 100 gms. solution at room temperature.

Lower Layer			Upper Layer		
Water	AcOH	Gasoline	Water	AcOH	Gasoline
28	72	0	0	8	92
18	81	1	0	12	88
13	85	2	0	16	84
8	88	4	0	20	80
4	86	10	0	30	70
1	59	40	Plait Point		



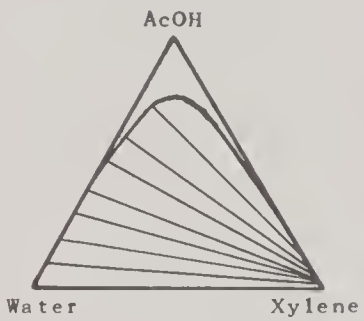
ACETIC ACID - $C_7H_{14}O_2$, Amyl Acetate

See acetic acid-ethyl acetate.

ACETIC ACID - C_8H_{10}, Xylenes (II 112).

Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	AcOH	Xylene
17.3	75.2	7.5
8.4	70.4	21.2
4.5	56.1	39.4
1.0	33.0	66.0



Scheibel and Karr (1950) gave the distribution between water and o-xylene in gms. per 100 gms:

Lower Layer	Upper Layer
1.02	0.0098
2.03	0.0275
6.13	0.135
9.66	0.301
14.77	0.614
20.65	1.111
25.9	1.63
30.45	2.16
34.55	2.70

Additional data on these systems are given by Orton and Jones (1919); Il'insky and Ivanov (1938) and Shilov and Lepin (1922).

ACETIC ACID

Distribution coefficients of Acetic and Lactic Acids between water and Immiscible Organic Liquids at 26 to 31°.

Leonard, Peterson, and Johnson (1948).

$$K = \frac{\text{Gms. acid per 100 ml. aqueous layer}}{\text{Gms. acid per 100 ml. organic layer}}$$

Solvent	K-Acetic	K-Lactic
Acetophenone		8.3
Amyl acetate (pentaacetate)		8.8
Amyl acetate (fusel oil)	2.47	11.0
n-Amyl alcohol	1.11	2.45
Amyl alcohols (pentasol)[a]	1.05	2.30
Isoamyl alcohol		2.22
Amylcyclohexanol		7.0
n-Amyl ether	14.2	100
Amyl lactate	1.26	2.88
Benzyl alcohol		2.33
n-Butanol	0.89	1.37
Isobutanol	0.85	1.60
Butyl acetate	2.03	8.2
sec-Butyl carbinol	1.01	2.46
Butyl carbitol acetate	1.36	4.1
Butyl cellosolve acetate		9.3
n-Butyl ether	11.8	73
n-Butyl lactate[a]	0.98	1.88
Isobutyl lactate	1.02	1.86
Chloroform		100
Cyclohexanol[a]		1.74
Cyclohexanone[a]	0.83	1.87
Cyclohexyl acetate		13.0
p-Cymene		600
Diethylcarbinol[a]	0.87	2.03
Di-isobutyl ketone	7.0	36
Ether	2.07	9.8
Ethyl acetate		4.07
2-Ethylbutanol	1.52	3.64
Ethyl carbonate	3.53	21.0
2-Ethylhexanol	1.97	6.8
Eugenol		14.7
Furane		80
Furfural	1.30	3.32
n-Hexyl alcohol	1.37	3.40
Limonene		280
Mesityl oxide[a]		3.76
Methyl-n-Amyl ketone[a]	2.48	9.7
Methyl Isobutyl ketone[a]	2.07	7.9
Nitroethane		11
2-Octanol	1.63	5.2

TERNARY AQUEOUS SYSTEMS

ACETIC ACID

Solvent	K-Acetic	K-Lactic
n-Octanol	1.98	5.2
Phenol		1.35
Phenyl Cellosolve	1.19	2.41
Phenylethanol		2.36
Phoron		15.7
iso Phoron	0.87	2.33
Pinene		80
Iso propyl ether		35
Terpineol	1.24	3.84
Turpentine (sulfite)	70	100

(a) Values at 90° or 100° also are given.

Additional distribution coefficients are given for acetic acid between water and:

n-Amyl alcohol (1), (2), (3)
tert-Amyl alcohol (1)
Aniline (1)
Anisol (2)
Benzaldehyde (3)
Benzene (1), (2), (3)
Bromobenzene (2)
Bromoform (1)
p-Bromotoluene (2)
n-Butanol (1), (2)
sec-Butanol (1)
2-Butanone (Methyl ethyl ketone (1)
Carbon disulfide (1), (2)
Carbon tetrachloride (1), (2)
Chloroform (1), (3)
Collodion (1)
Cottonseed oil (1)
Cyclohexane (4)
Tetralin (5)
Cymene (2)
Epichlorohydrin (1)
Ether (1), (3)
Ethyl acetate (3)
Gasoline (octanes) (2)
Hexane (2)
Isoeugenol (2)
Isopropyl ether (1)
Kerosene (1)
Nitrobenzene (1), (2), (3)
o-Nitrotoluene (1)
Olive oil (1)
Pentane (2)
Petroleum ether (1), (3)
Phenetol (2)
Toluene (2), (3)
o-Xylene (1)
m-Xylene (1), (2)
p-Xylene (1)

(1) Seidell, Vol. II, pp. 104-113
(2) Orton and Jones (1919).
(3) Waentig and Pescheck (1919).
(4) Jones and Betts (1928).
(5) Int. Crit. Tables III 424

Critical solution temperatures are given for acetic acid with many animal and vegetable oils (II 830).

Marvel and Richards (1949) presented distribution coefficients of eight acids with 13 solvents and of 18 acids with five solvents. Most of the coefficients with benzene, carbon tetrachloride, chloroform, and Skellysolve B, are over 10 except with acids of low oxygen content. With oxygen containing solvents, the coefficients are much lower, many of them below 0.1.

$C_2H_4O_3$ - Glycolic Acid, $CH_2OHCOOH$

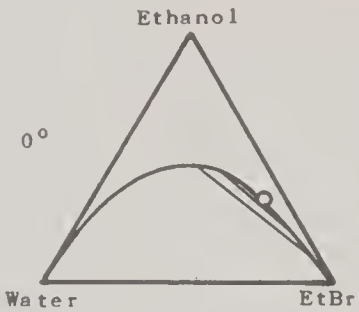
$C_4H_{10}O$, Ether (II 117-8).
$C_5H_{12}O$, n-Amyl Alcohol (II 118).

C_2H_5Br - Ethyl Bromide.

Distribution of iodine (I 666); trichloroacetic acid (II 69) (solutrope); dichloroacetic acid, (II 78); chloroacetic acid (II 90); propionic acid (II 188) (solutrope), between water and ethyl bromide. See also methanol and isovaleric acid.

ETHYL BROMIDE - C_2H_6O, Ethanol, (II 132).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.



Water	Ethanol	Ethyl Bromide	
83.2	15.4	1.4	
52.0	42.1	5.9	
37.0	47.1	15.9	
27.3	45.4	27.3	
22.8	43.0	34.2	
18.3	39.6	42.1	
13.2	33.8	53.0	
11.7	31.0	57.3	P.P.
7.3	22.0	70.7	
2.6	19.3	78.1	

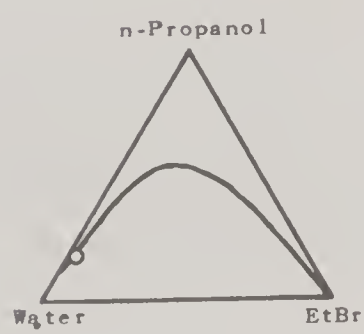
Tie lines (recalculated)

Wt. % Ethanol in:

Aqueous Layer	EtBr
38	21
44	7

ETHYL BROMIDE - C_3H_8O, n-Propanol (II 205).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.



Water	Propanol	Ethyl Bromide	
79.6	18.5	1.9	P.P.
52.7	35.9	6.4	
44.2	44.8	11.0	
35.8	48.4	15.8	
24.0	52.9	23.1	
19.2	52.1	28.7	
15.0	50.0	35.0	
10.8	46.0	43.2	
6.1	39.0	54.9	
2.9	26.8	70.3	

No tie lines are given. However, the shift of the plait point to the left side of the curve shows that the higher alcohol is extracted mostly by the ethyl bromide layer.

C_2H_5OCl - β-Chloroethanol, $ClCH_2CH_2OH$.

Distribution coefficients are given between water and 47 organic solvents including aldehydes, ketones, esters, hydrocarbons, halohydrocarbons, nitrobenzene, and alcohols. (C. Weizmann and five co-workers, J. Soc. Chem. Ind. 67, 203 1948). The first three groups give the most favorable distribution for extraction by the solvent.

C_2H_5OCl - Ethyl Hypochlorite (II 120).

Distribution in carbon tetrachloride (II 120).

$C_2H_5O_2N$ - Glycine (glycocoll), NH_2CH_2COOH.

Distribution in n-butanol. (II 125).

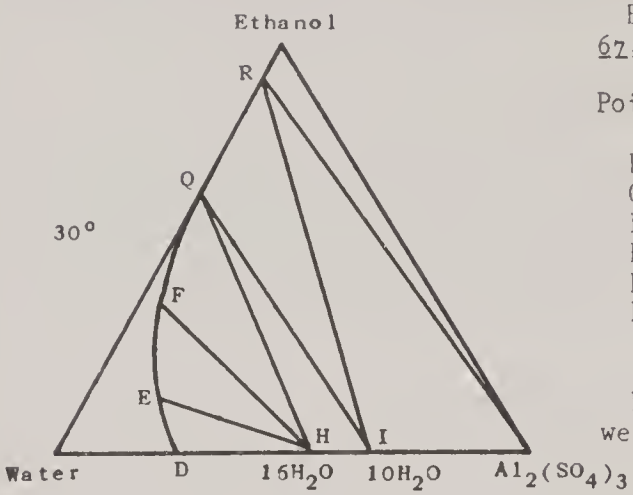
$C_2H_5O_2N$ - Nitroethane - $C_3H_6O_3$, Lactic Acid.

See Acetic Acid.

$C_2H_5O_2N$ - Methyl Carbamate (Methyl Urethane), NH_2COOCH_3.

Distribution in olive oil (II 122, 203). The name "methyl urethane" is used carelessly in the literature referring either to NH_2COOCH_3, which is preferably "methyl carbamate", or to $CH_3NHCOOC_2H_5$ which is preferably "N-methylurethane". The references on II 122, 202, 203, 265 all refer to the former although the formula and empirical formula of the latter are given incorrectly on II 265. This applies also to the reference in Int. Critical Tables III 426, col. 4. A similar correction should be made to the formulas of propyl urethane (bottom of II 452) and butyl urethane (II 566). Two of the formulas on II 202 for urethanes should contain two oxygen atoms. On p. II 203 in Odaira's table (1916 not 1915) for "n-isoamyl urethane" read "Diethyl-N-methylurethane".

C_2H_6O - Ethanol - $Al_2(SO_4)_3$ - Aluminum Sulfate

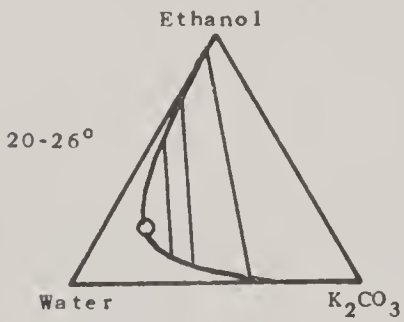


E. A. Gee, J. Am. Chem. Soc. 67, 180 (1945).

Point	Water	Ethanol	$Al_2(SO_4)_3$
R	4.8	95.1	0.1
Q	33.6	66.4	0
F	58.1	38.1	3.8
E	65.0	15.5	19.5
D	72.3	0	27.7
H	45.7	0	54.3
I	34.5	0	65.5

Densities also are given as well as the complete graph at 80°.

ETHANOL - K_2CO_3, Potassium Carbonate (I 737-8). Koblyanski (1936).



Gms. per 100 gms. at 20°

Layer	Water	Ethanol	K_2CO_3
Lower	63.5	5.7	30.8
Upper	41.8	56.8	1.36

Nikol'skaya (1946).

Gms. per 100 gms. at 25°

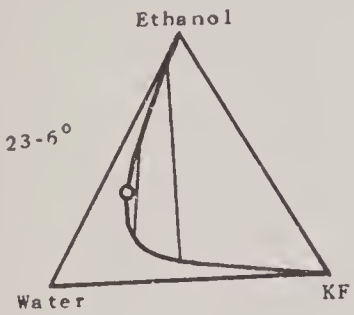
Lower Layer			Upper Layer		
Water	Ethanol	K_2CO_3	Water	Ethanol	K_2CO_3
67.04	15.23	17.73	62.23	27.7	10.07
67.60	5.60	26.80	49.27	47.87	2.86
59.67	1.13	38.90	26.66	72.81	0.53
46.91	0.29	52.80	9.33	90.50	0.17

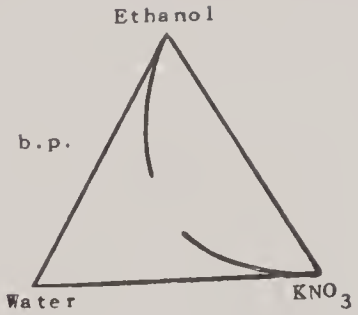
Results given at 50° and 75° are nearly the same.

ETHANOL - $K_2CO(CNS)_4$ - Potassium Cobaltothiocyanate.

(Int. Crit. Tables III 422).

ETHANOL - KF, Potassium Fluoride (I 805).





ETHANOL - KNO_3 - Potassium Nitrate.

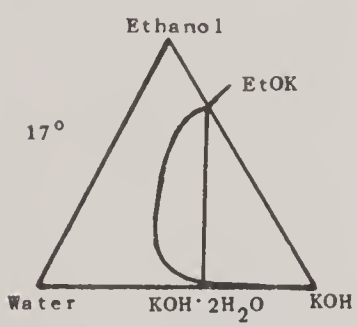
Recalculated from graph. Temperature 80.4° for two liqnid portion. Vapor composition 82.6% ethanol. R. M. Rieder and A. R. Thompson, Ind. Eng. Chem., 42, 379 (1950).

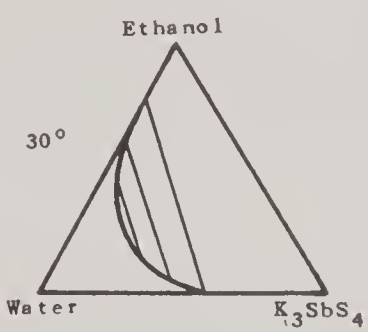
ETHANOL - KOH, Potassium Hydroxide (I 852).

G. Peyronal, Gazz. Chem. Ital. 79, 792-9 (1949)

Gms. per 100 gms.

Temp.	Lower Layer			Upper Layer		
	Water	Ethanol	KOH	Water	Ethanol	KOH
17	46.56	0.64	52.80	13.50	56.40	30.10
17	50.47	0.93	48.60	17.30	55.15	27.55
17	53.21	1.34	45.45	19.13	54.52	26.35
17	57.41	2.77	39.84	27.12	48.95	23.93
17	57.19	10.13	32.68	43.42	29.50	27.08
30	42.86	0.48	56.66	9.57	58.70	31.73
60	39.00	-	61.00	6.78	60.50	32.72
90	36.45	-	63.55	5.22	59.70	35.08





ETHANOL - K_3SbS_4, Potassium Sulfoantimonate (I 857).

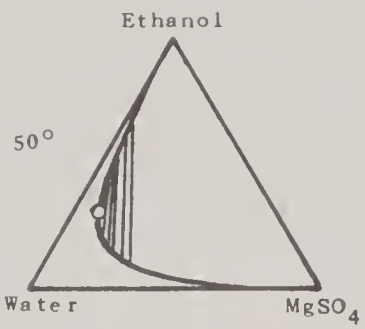
ETHANOL - $MgSO_4$ - Magnesium Sulfate (I 993).

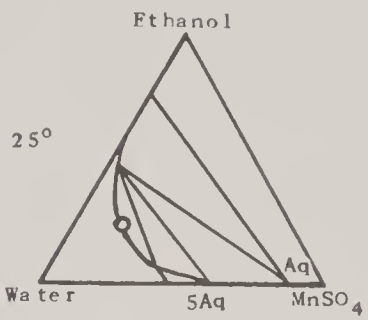
Nikol'skaya (1946).

Gms. per 100 gms. at 50°C

Lower Layer			Upper Layer		
Water	Ethanol	$MgSO_4$	Water	Ethanol	$MgSO_4$
68.92	16.00	15.08	64.42	27.90	7.68
68.79	9.91	21.30	58.92	37.93	3.15
66.67	5.93	27.40	48.33	51.00	0.67
65.13	4.28	30.50	40.80	58.94	0.26

Data given at 75° are nearly the same.





ETHANOL - $MnSO_4$, Manganous Sulfate (I 1013).

ETHANOL - NH_4NO_3, Ammonium Nitrate (I 1112).

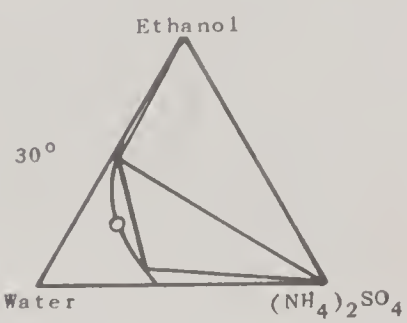
At 67.5° two layers are formed at certain concentrations.

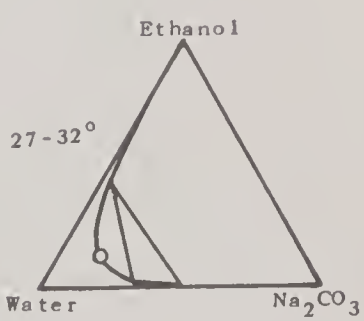
ETHANOL - $(NH_4)_2SO_4$, Ammonium Sulfate (I 1129-30). Koblyanski (1936).

ETHANOL - Na_2CO_3, Sodium Carbonate, (I 1211).

Gms. per 100 gms. Solution at 30°

	Water	Ethanol	Salt
Lower Layer	56.2	10.7	33.1
Upper Layer	49.0	47.0	4.05



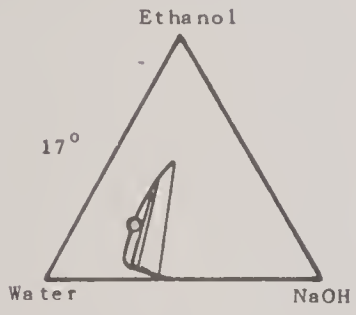


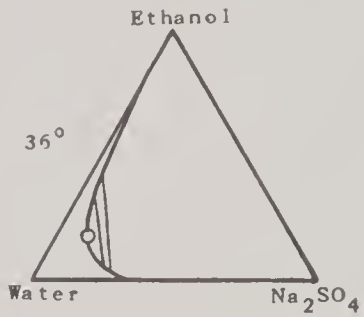
ETHANOL - NaOH, Sodium Hydroxide.

G. Peyronel, Gazz. Chim. Ital., 79, 792-9, (1949)

Gms. per 100 gms.

Temp.	Lower Layer			Upper Layer		
	Water	Ethanol	NaOH	Water	Ethanol	NaOH
17	59.62	0.84	39.54	24.52	52.20	23.28
	65.88	2.77	31.35	33.25	48.45	18.30
	65.95	7.35	26.70	47.84	33.50	18.66
	54.20	23.90	21.90	Plait Point		
30	57.04	0.76	42.20	19.80	56.13	24.07
60	55.55	-	44.45	13.42	64.20	22.38
90	52.55	-	47.45	9.81	71.20	18.99

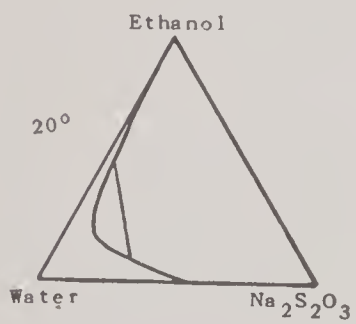


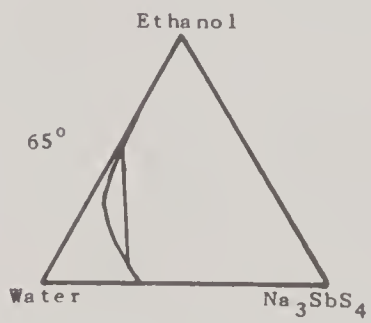


ETHANOL - Na_2SO_4, Sodium Sulfate (I 1313).

ETHANOL - $Na_2S_2O_3$, Sodium Thiosulfate (I 1318).

ETHANOL - Na_3SbS_4, Sodium Sulfoantimonate (I 1321).





ETHANOL

ETHANOL - See CCl_4, CS_2, $CHCl_3$, CH_3I, C_2HCl_3, $C_2H_2Cl_2$, $C_2H_4Cl_2$, C_2H_5Br, C_5H_{10} (Trimethylethylene).

ETHANOL - $C_nH_{2n}O_2$, Esters.

H. Pfeiffer, Z. Physik. Chem., 9, 469 (1892) observed a few points for each of the systems of water, ethanol, and 23 esters and isoamyl alcohol. In the following table are given the gms. ethanol per 100 gms. solution at 20° at the apex of the curve and the page number in Seidell Vol. II.

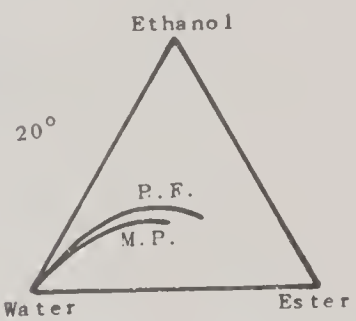
Ester	Apex	Ref.	Ester	Apex	Ref.
Methyl			Propyl		
Formate	< 20	-	Formate	32.0	-
Acetate	< 20	-	Acetate	26.7	300
Propionate	25.4	-	Propionate	39.4	437
Butyrate	33.2	135	Butyrate	45.1	565
Isovalerate	38.3	135	Butyl		
Ethyl			Formate	29.4	300
Formate	< 20	-	Acetate	35.5	437
Acetate	21.6	248	Amyl		
Propionate	33.4	300	Formate	38.7	436
Butyrate	39.0	437	Acetate	38.2	565
Valerate	41.7	565	Isoamyl		
Isovalerate	44.1	565	Acetate	39.5	565
Chloroacetate	40.2	238	Isoamyl		
Dichloroacetate	48.0	238	Alcohol	28.5	314
Trichloroacetate	53.0	238			

No tie lines or plait points are given. The former probably slope down toward the ester corner and the latter are near the right side except for the esters up to C_4. For the C_2 and C_3 esters Pfeiffer merely stated that equal volume mixtures of ethanol and ester were miscible with water. The following data for C_4 esters are not included in Seidell Vol. II.

Compositions in gms. per 100 gms. solution at 20°.

Water	Ethanol	Methyl Propionate
92.8	0	7.2
62.5	24.0	13.5
46.0	25.4	28.6

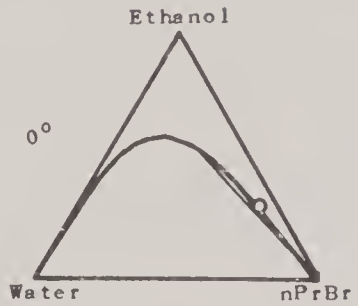
Water	Ethanol	Propyl Formate
97.5	0	2.5
75.4	20.6	3.85
67.4	26.6	6.0
63.7	28.3	8.0
57.7	30.8	11.5
50.0	32.0	18.0
35.7	30.3	34.0



ETHANOL - C_3H_7Br, n-Propyl Bromide (II 144).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	nPrBr	
57.8	40.6	1.6	
44.8	50.5	4.7	
37.5	52.9	9.6	
27.9	53.5	18.6	
19.9	50.3	29.8	
16.0	46.8	37.2	
11.6	41.9	46.5	
6.7	33.3	60.0	
5.6	29.6	64.8	P.P.
2.1	16.0	81.9	



Tie lines, % Ethanol in:

Aqueous	nPrBr Layer
42	13
38	19
37	20

ETHANOL - $C_4H_4N_2$, Succinonitrile, $CNCH_2CH_2CN$.

F. A. H. Schreinemakers, Z. physik. Chem. 27, 95 (1898).

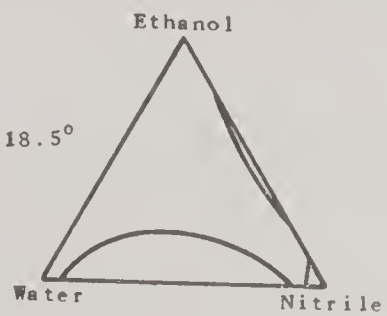
For over fifty years this has been the only published system of three components with two separate binodal curves, and so has been cited in many textbooks. The curves shown by Schreinemakers were schematic and highly distorted and these have been copied in the textbooks (often further distorted) for illustrative purposes. Compositions are given in gms. per 100 gms. solution for the two curves at 18.5°.

Water	Ethanol	Nitrile
8.0	0	92
9.33	1.47	89.2
74.8	12.1	13.1
85.9	6.7	7.4
94.6	0	5.4

Water	Ethanol	Nitrile
0	85.3	14.7
4.7	65.7	29.6
2.2	31.2	66.6
0	23.6	76.4

Compositions in equilibrium with solid nitrile, m.p. 55.5°C.

Water	Ethanol	Nitrile
8.0	0	92.0
7.0	1.1	91.9
4.1	5.1	90.8
2.9	7.2	89.9
0	15.4	84.6



ETHANOL - $C_4H_5O_2Cl_3$, Ethyl Trichloroacetate (II 238).

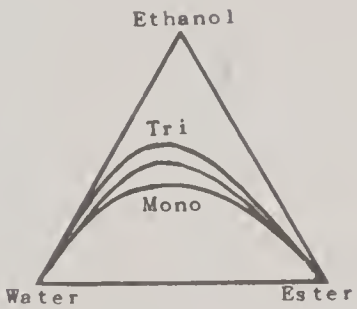
ETHANOL - $C_4H_6O_2Cl_2$, Ethyl Dichloroacetate.(II 238).

ETHANOL - $C_4H_7O_2Cl$, Ethyl Chloroacetate (II 238).

Pfeiffer's data at room temperature recalculated to gms. per 100 gms. solution.

Water	Ethanol	$C_4H_5O_2Cl_3$
28.7	53.0	18.3
24.7	52.6	22.7
21.0	50.1	28.9
16.7	44.7	38.6
9.0	33.3	57.7

Water	Ethanol	$C_4H_6O_2Cl_2$
36.7	48.0	15.3
33.0	48.0	19.0
28.2	46.8	25.0
22.1	43.3	34.6
12.6	33.5	53.9



		$C_4H_7O_2Cl$
58.6	34.3	7.1
55.3	36.0	8.7
51.2	37.8	11.0
45.2	40.2	14.6
40.6	40.0	19.4
32.7	39.0	28.3
18.3	33.3	48.4

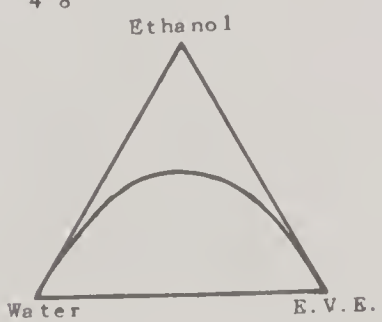
ETHANOL - $C_4H_8Cl_2S$, $\beta\beta$,Dichloroethyl Sulfide, 'Mustard gas' S $(C_2H_4Cl)_2$ (II 242).

Solubility in absolute and 92.5% ethanol.

ETHANOL - C_4H_8O, 2-Butanone or Methyl Ethyl Ketone (II 243).

Mutual solubility in water and 1.5% ethanol. The latter has an upper critical solution temperature of 148° and a lower one of 16°.

ETHANOL - C_4H_8O, Ethyl Vinyl Ether $C_2H_5OCH = CH_2$. (Siggia and Hanna, 1949)



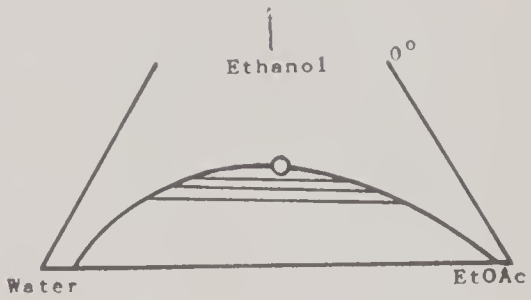
No numerical data were presented, but the graph was stated to be similar to that of glycerol-acetic acid-benzene, with a peak at about 50% ethanol.

ETHANOL - $C_4H_8O_2$, Methyl Propionate (See page 908)

ETHANOL - $C_4H_8O_2$, Ethyl Acetate (II 132, 134, 248).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	EtOAc	
78.6	12.5	8.9	
62.7	22.0	15.3	
53.5	23.6	22.9	
45.8	23.6	30.6	
40.0	23.1	37.0	P.P.
31.0	22.5	46.5	
24.8	20.9	54.3	
16.4	18.6	65.0	
8.9	11.5	79.6	
7.3	9.1	83.6	



Tie lines. Wt. % ethanol in:

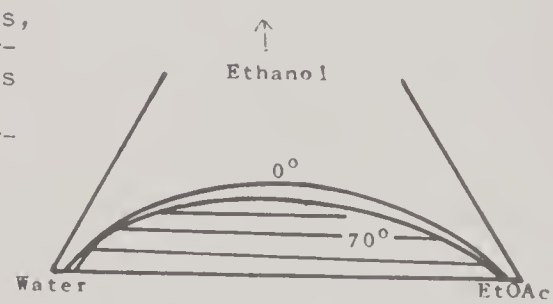
Aqueous	Ester Layer
16	15
20	18
21.5	20.5

Beech and Glasstone's observations at 0° (II 134) indicate much steeper tie lines.

The system was studied also by J. Griswold, P. L. Cha, and W. O. Winsauer, Ind. Eng. Chem., 41, 2352 (1949) at 0° and 70°. The data at 70° in gms. per 100 gms. solution.

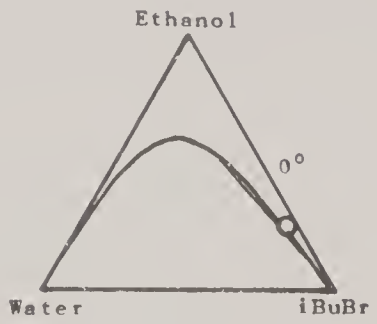
Aqueous Layer			Acetate Layer		
Water	Ethanol	EtOAc	Water	Ethanol	EtOAc
93.7	0	6.3	5.8	0	94.2
88.0	4.5	7.5	8.2	3.1	88.7
76.5	11.3	12.2	16.6	10.9	72.5
68.9	13.8	17.3	23.6	14.5	61.9

Specific gravities, boiling points, and vapor liquid equilibria for ternary systems are presented in tables and graphs. The data indicate that the system is solutropic with a horizontal tie line at about 13% ethanol.



ETHANOL - $C_4H_8O_2$ - Propyl Formate (See page 908)

ETHANOL - C_4H_9Br - Isobutyl Bromide (II 136).

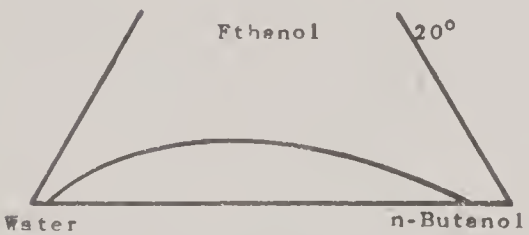


Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	iBuBr	
49.2	48.4	2.4	
34.5	56.9	8.6	
29.6	57.7	12.7	
21.8	56.4	21.8	
14.6	51.2	34.2	
10.9	45.4	43.7	
4.9	29.6	65.5	P.P.
2.0	16.7	81.3	

Tie line, 48% ethanol in aqueous layer and 21% in Bromide layer.

ETHANOL - $C_4H_{10}O$, n-Butanol (II 135).

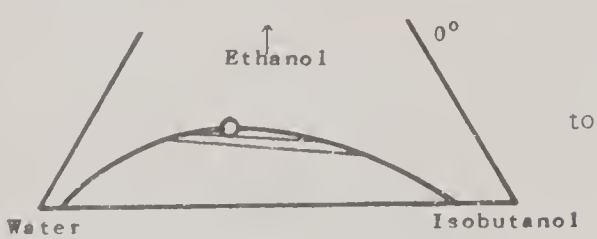


Druillon's data at 20° recalculated to gms. per 100 gms. solution. The coordinates give points on the binodal curve, but they are not conjugate solutions (tie lines). Drouillon gave the latter, but his paper is not available to the compiler." Delete "Aqueous layer" and "Butanol layer". After 20 and 30° add "and by Brun (1925) at 0°, who reported the plait point as 61% water, 16% ethanol, 23% n-butanol.

Aqueous Layer			Butanol Layer		
Water	Ethanol	n-Butanol	Water	Ethanol	n-Butanol
93.4	0	6.6	18.4	0	81.6
90.9	2.3	6.8	18.4	0.5	81.1
82.5	9.3	8.2	19.6	2.2	78.2
66.45	14.15	19.4	20.9	4.4	74.7
44.7	14.9	40.4	25.7	8.6	65.7

Additional data are given by Bogin (1924) at 20° and 30°.

ETHANOL - $C_4H_{10}O$, Isobutanol (II 136, 268).



Tie lines: Percentage ethanol in:

Aqueous Layer	Butanol Layer
15.9	12.0
16.4	15.0
16.6	15.7
16.7	16.7

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

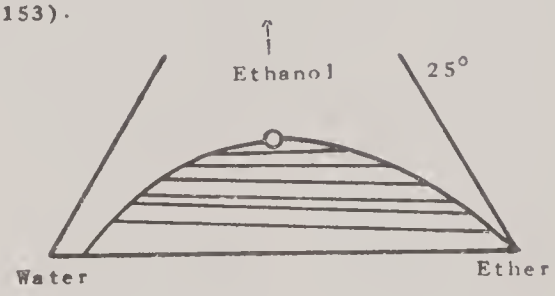
Water	Ethanol	Isobutanol	
73.0	15.9	11.1	
66.6	16.7	16.7	
57.8	17.4	24.8	
53.7	17.3	28.9	P.P.
50.0	16.7	33.3	
41.7	16.7	41.7	
35	15.0	50.0	
26.6	11.5	59.9	

ETHANOL

P. Brun, Compt. rend., 180, 1745 (1925); 183, 207 (1926) presented isotherms for this system at 0°, 40°, 80°, 120°with the tie lines at 0°. The plait point at 0° is 52.7% water, 15.7% ethanol.

ETHANOL - $C_4H_{10}O$, Ether (II 130-3, 153).

Corrections: On p. II 153, under "Results at 0°, H_2O", read 13.0 instead of 18.9. Under "Gms. per 100 gms. upper layer" the first item should be 8.7 instead of 8.2, and the last line should be 26.7, 22.3, 51.0. In column 5 instead of 16.9 read 16.0.

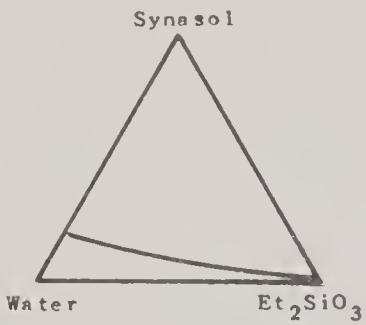


Additional data on this system are given by Bogin (1924); Holmes (1918) (a single point 28.0% water, 27.6% ethanol and 44.4% ether); M. Kono, J. Chem. Soc. Japan, 44, 406 (1923), Chem Abstracts 17, 2986 (complete graph in abstract); M. Margueyrol and E. Goutal Mem. poudres 19, 368 (1922) (graph at 15° but no numerical data); L. Y. Ruderman, J. priklad. Khim., 20, 908 (1947); A. Sanfourche and A. N. Boutini, Bull. soc. chim., 31, 546 (1922); and Vlček (1935).

Since the graph is almost independent of temperature over a considerable range, only one curve is shown. The tie lines shift slightly with temperature, however, so that at 25° the system is solutropic, with a horizontal tie line at about 24.6% ethanol. At 0° and at -15° it is not solutropic.

ETHANOL - Ethyl Silicate.

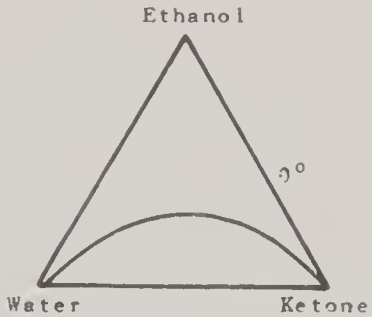
H. D. Cogan and C. A. Setterstrom, Ind. Eng. Chem., 39, 1364 (1947); Chem. Eng. News, 24, 2499, (1946). The "synasol solvent" is a specially denatured alcohol. Equilibria are partly chemical involving hydrolysis. No temperature is given.



ETHANOL - C_5H_{10}, Trimethylethylene.

Ormandy, Pond, and Davies(1934). Water tolerance at low ethanol concentrations.

ETHANOL - $C_5H_{10}O$, 3-Pentanone or Diethyl Ketone (II 131, 298-9).

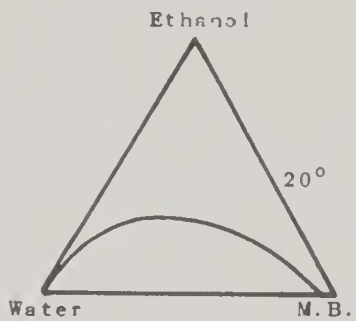


Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Ketone
42.4	28.7	28.9
35.5	29.2	35.3
28.7	28.2	43.1
22.0	26.3	51.7
15.3	23.6	61.1
8.7	16.7	74.6
5.5	12.0	82.5

No tie lines are given. However, since the curve is almost coincident with that for ethanol-ether, the tie lines are probably nearly horizontal, as for that system.

ETHANOL - $C_5H_{10}O_2$, Methyl n-Butyrate (II 135, 300).

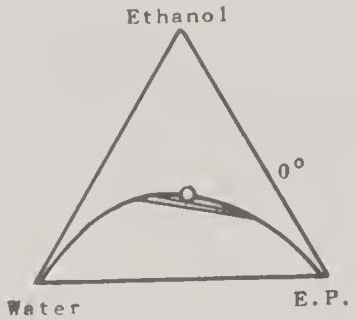


Pfeiffer's data at 20° recalculated to gms. per 100 gms. solution.

Water	Ethanol	M.B.
73.7	22.7	3.6
69.4	25.8	4.8
65.7	28.1	6.2
56.2	32.0	11.8
48.3	33.2	18.5
31.6	32.4	36.0

No tie lines are given, but the shape of the curve indicates they would slope down toward the right.

ETHANOL - $C_5H_{10}O_2$ - Ethyl Propionate (II 132, 300).



Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	E.P.	
61.7	31.5	6.8	
52.7	34.1	13.2	
45.2	35.5	19.3	
39.3	34.7	26.0	
35.3	34.7	30.0	P.P.
26.8	32.9	40.3	
21.0	31.2	47.8	
14.5	27.5	58.0	
7.9	21.3	70.8	
2.0	12.2	85.8	

ETHANOL - $C_5H_{10}O_2$ - Ethyl Propionate (Con.).

Tie lines. Wt. % Ethanol in:

Aqueous	Ester Layer
31.0	23.2
33.3	29.0
34.7	31.9
35.3	33.0

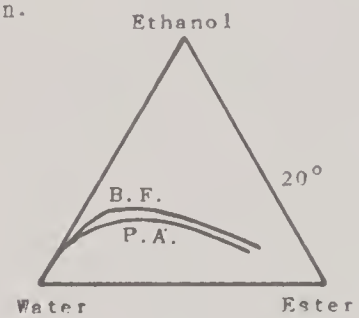
Pfeiffer's and Traube's data at room temperature recalculated to gms. per 100 gms. solution.

Water	Ethanol	E.P.
98.3	0	1.7 (22°)
72.1	24.0	3.9
64.8	28.7	6.5
55.5	32.4	12.1
47.8	33.4	18.8
31.2	32.4	36.4

ETHANOL - $C_5H_{10}O_2$, n-Propyl Acetate (II 300).

Pfeiffer's and Fuhner's data at 20° recalculated to gms. per 100 gms. solution.

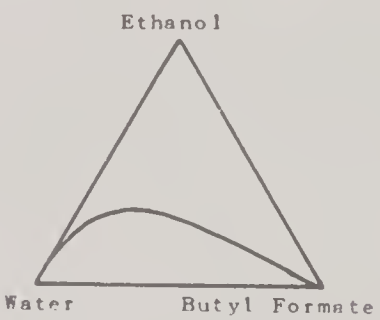
Water	Ethanol	P.A.
98.1	0	1.9
75.2	21.4	3.4
70.9	23.8	5.3
64.3	26.0	9.7
58.4	26.7	14.9
47.1	25.0	27.9



ETHANOL - $C_5H_{10}O_2$, Butyl Formate (II 300).

Pfeiffer's data at 20° recalculated to gms. per 100 gms. solution.

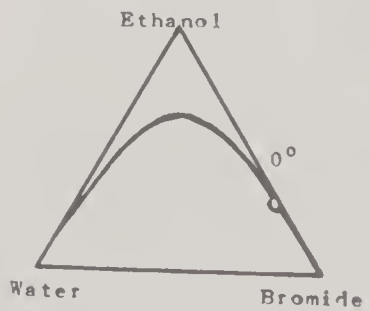
Water	Ethanol	B.F.
72.7	23.6	3.7
63.6	28.6	7.9
54.2	29.4	16.4
40.4	28.2	31.4



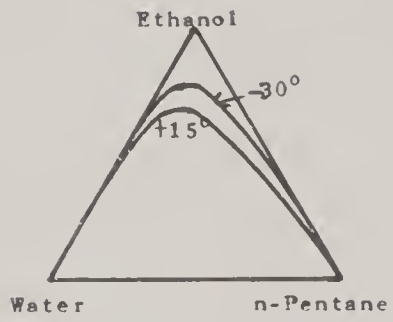
ETHANOL - $C_5H_{11}Br$, Isoamyl Bromide (II 136).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Bromide	
48.7	50.2	1.1	
36.6	59.3	4.1	
25.5	63.6	10.9	
18.8	62.6	18.6	
12.7	57.8	29.5	
6.0	40.5	53.5	
2.9	26.5	70.6	P.P.
2.0	20.0	78.0	



ETHANOL - n - Pentane and Isopentane (II 146)



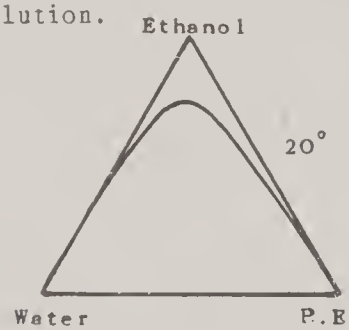
Data at -30°, 0°, and + 15°.

Although not given, the plait points would undoubtedly be far to the right, and the tie lines would point almost toward the pentane corner.

CORRECTIONS: The titles of the middle table on p. II 146 and the top table on p. II 147 should read "Reciprocal Solubility as Liquids of...", etc. and for "F. pt." read "Temp." as column headings (five times). Both footnotes should read "separation" instead of "freezing".

ETHANOL - Petroleum Ether

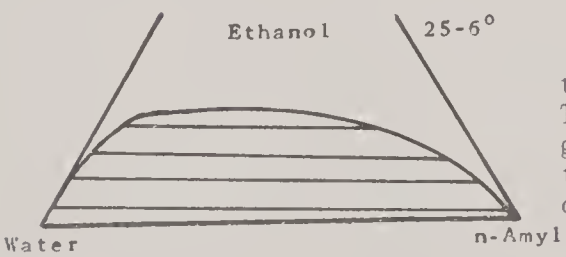
The data of Bogin (1924) are recalculated from a curve to gms. per 100 gms. solution.



Water	Ethanol	P.E.
26.5	68.5	5.0
20	72.6	7.4
16	74	10
11.5	73.5	15
6	67	27

ETHANOL - $C_5H_{12}O$, n-Amyl Alcohol.

Othmer, White, and Trueger (1941).



The ethanol concentrations for the tie lines are given in the original. The concentrations in gms. per 100 gms. solution are interpolated from the compositions given for the binodal curve.

Water	Ethanol	$C_5H_{12}O$	Water	Ethanol	$C_5H_{12}O$
99.4	0	0.6	10.2	0	89.8
95.3	3.97	0.7	10.85	2.37	86.8
87.6	11.60	0.8	14.2	10.03	75.8
81.9	17.23[a]	0.86	18.8	16.43[a]	64.8
-	-	-	25.9	25.5	48.6[b]
74.4	24.2	1.4	28.7	23.6	47.7
58.3	25.7	16.0	-	-	-
54	26	20.0[c]	-	-	-

(a) These values were interchanged in the original, apparently a typographical error.

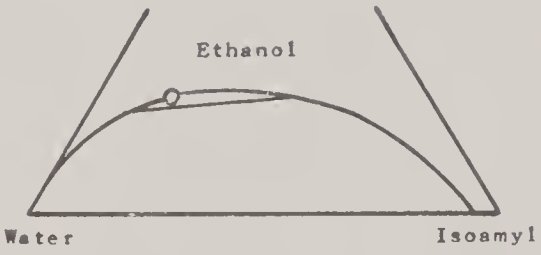
(b) This point was calculated from the data of Holmes (1918).

(c) This point was calculated from the data of E. Duclaux, Compt. rend., 81, 817; B.C.A. 1876 i 336.

ETHANOL - $C_5H_{12}O$, Isoamyl Alcohol (II 136, 313-4).

Bonner's data at 0°C recalculated to gms. per 100 gms. solution.

Water	Ethanol	$C_5H_{12}O$	
65.8	26.9	7.3	
57.1	29.1	13.8	
51.0	30.0	18.9	P.P.
41.3	31.2	27.5	
34.8	31.0	34.2	
27.9	30.0	42.1	
21.9	28.4	49.7	
16.1	20.5	63.4	
8.7	10.4	80.9	



Tie lines: Wt. % Ethanol in

Aqueous Layer	$C_5H_{12}O$
26	30.0
27.6	31.1
28.4	30.9

Fontein (1910). Fermentation amyl alcohol, gms. per 100 gms. at 28°.

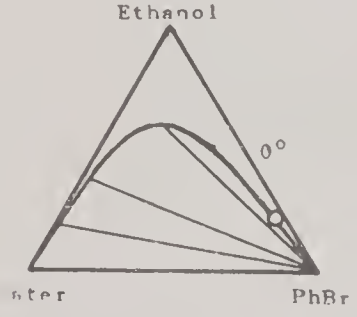
Lower Layer			Upper Layer		
Water	Ethanol	$C_5H_{12}O$	Water	Ethanol	$C_5H_{12}O$
97.7	0	2.3	9.8	0	90.2
88.5	8.8	2.7	14.0	10.6	75.4
80.8	15.9	3.3	21.5	19.9	58.6
66.0	23.0	11.0	42.4	26.2	31.4
55.0	25	20.0		Plait Point	

Fontein also gave data for isotherms at 15.5° and at 0°. The latter are almost coincident with the above data of Bonner. CORRECTION: In the table on p. II 313, at 67.8° under $C_5H_{11}OH$ read 74.4 instead of 24.4.

ETHANOL - C_6H_5Br, Bromobenzene (II 131, 141).

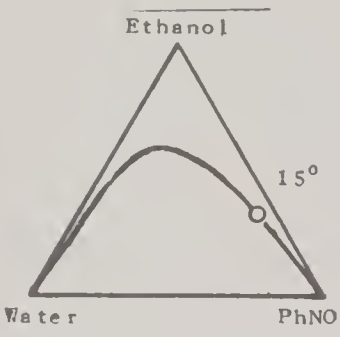
Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	PhBr
54.2	44.5	1.3
41.7	53.7	4.6
34.0	57.5	8.5
28.8	58.8	12.4
20.9	58.2	20.9
13.7	54.3	32.0
10.0	50.0	40.0
6.1	39.4	54.5
3.0	24.2	72.8
0.9	10.3	88.8



The tie lines are those given at 25°, but are probably not much different from those at 0°.

ETHANOL - $C_6H_5NO_2$, Nitrobenzene (II 141).



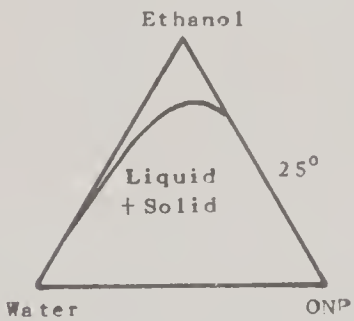
Tie lines: % Ethanol in

Aqueous	$PhNO_2$
41.5	18.7
39.3	23.4

Bonner's data at 15° recalculated to gms. per 100 gms. solution.

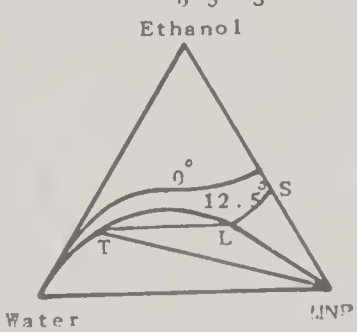
Water	Ethanol	$PhNO_2$	
61.3	37.5	1.2	
45.4	49.6	5.0	
36.4	54.8	8.8	
30.4	56.6	13.0	
25.6	57.3	17.1	
18.1	55.3	26.6	
14.4	52.1	33.5	
10.8	46.2	43.0	
6.0	32.9	61.1	P.P.
2.8	19.9	77.3	

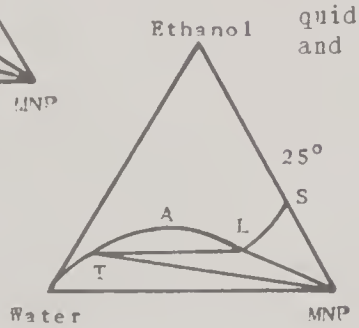
ETHANOL - $C_6H_5NO_3$, o-Nitrophenol (II 353).



This system does not separate into two liquid layers at 25°, the temperature reported. At some higher temperature, e.g. 40° it would undoubtedly give two liquids and a solid, like the isomeric nitrophenols.

ETHANOL - $C_6H_5NO_3$, m-Nitrophenol (II 353).



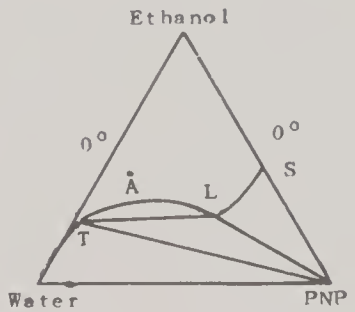


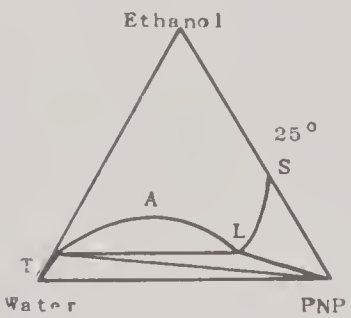
At 0° the system involves a solid and only one liquid. However, the flatness of the solubility curve indicates that it is about to "break" into a tie line and a binodal curve for two liquid phases, as shown for 12.5° and higher temperatures.

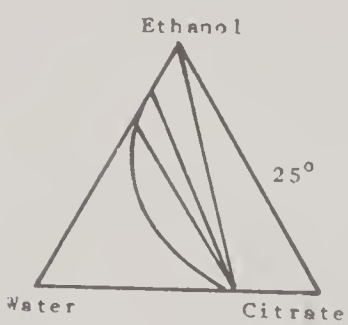
ETHANOL - $C_5H_5NO_3$, p-Nitrophenol (II 364).

A solid and two liquid phases are involved at all four temperatures, 0, 12.5°, 25°, and 40°, reported.

Data for these systems were plotted on a large scale and the important points were taken from the plot and tabulated. The points listed with footnote (1) on pp II 363-4 are tie lines, TL, and all of them are straight when plotted. A is the apex of the binodal curve and is probably near the plait point (not reported), since all of the tie lines are nearly horizontal. Its content of water is only a rough estimate since the curves are very flat. Compositions in gms. per 100 gms. solution.





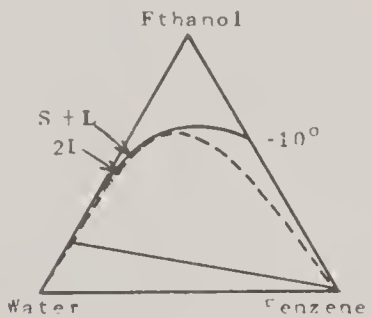


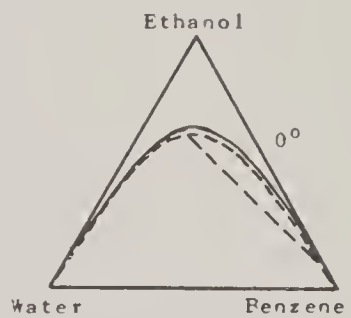
Nitro-Phenol	Temp.	Pt.	Water	Ethanol	$C_6H_5NO_3$
Meta	12.5	T	71.5	22.5	6
		A	49	28	23
		L	28	23.3	48.7
		S	0	40.4	59.6
Meta	25	T	83	13	4
		A	49	24.7	26.3
		L	26	15	59
		S	0	33.9	66.1
Para	0	T	74	25	1
		A	45	32	23
		L	27	28	45
		S	0	46.2	53.8
Para	12.5	T	80	18	2
		A	49	22.3	29.7
		L	31	17	52
		S	0	40.5	59.5
Para	25	T	89	9	2
		A	50	22.2	28
		L	25	9	66
		S	0	34.6	65.4
Para	40	T	98	0	2
		A	45	19.3	36.7
		L	29	0	71
		S	0	28.6	71.4

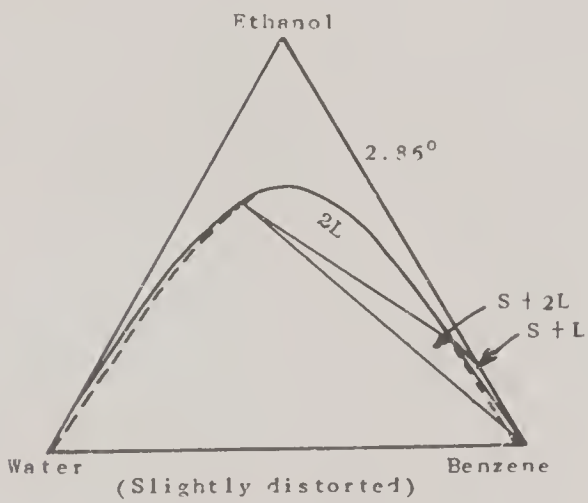
ETHANOL - $C_6H_5O_7K \cdot H_2O$, Potassium Citrate $(CH_2)_2COH(COOK)_3 \cdot H_2O$ (I 709).

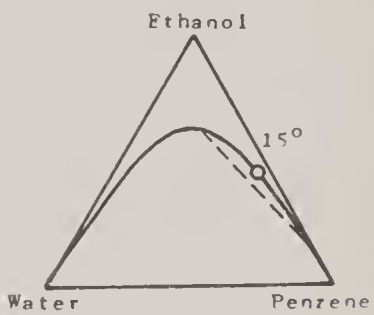
ETHANOL - C_6H_6, Benzene (II 137-140).

This system has been studied in at least 29 investigations at various temperatures from -10 to +60°. Some of the observations in Sidgwick and Spurrell's table (II 138) are equilibria with solid benzene, but all the rest (II 137-8) at temperatures below +3° are metastable equilibria with subcooled liquid benzene (dotted curves in the first three graphs). In the first graph the position of the solid line (equilibrium with benzene crystals) is conjectural. With rising temperature these two curves approach and contact each other at the plait point at about 2.5°. The "triple point" at the bottom of p. II 138 is the composition of the aqueous layer in equilibrium with a benzene rich layer and with benzene crystals (third graph).





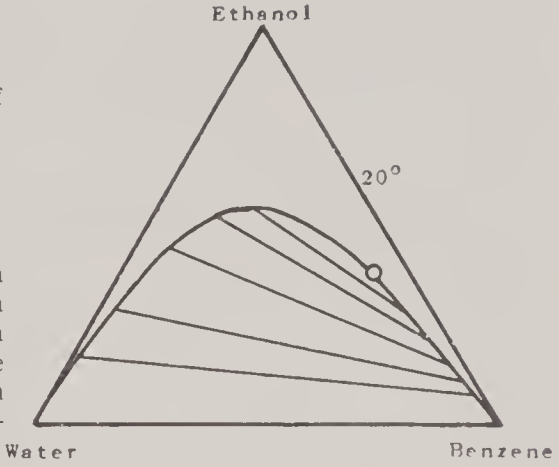




TERNARY AQUEOUS SYSTEMS

ETHANOL

At temperatures below 19°C (but not above) the system has an isopycnic, (dashed tie line at 0°, 10°) so that for tie lines near the plait point the benzene-rich layer is heavier. CORRECTIONS: On p II 137, instead of 60.75 gms. C_2H_5OH per 100 gms. upper layer read 52.75; on p II 139, top table instead of 49.04 read 49.94% C_2H_5OH and instead of 59.50 read 58.50% H_2O; in middle table, column 2 instead of 51.05 read 57.05; column 7 instead of 30.96 read 36.96; column 8 instead of 79.40 read 79.90; column 10 instead of 40.50 read 46.50. Some of these were typographical errors in the original. On p II 138, lower table, asterisks should be added to 43.70, 43.08, and 27.95 in columns 8 and 9.



(K. I. Mochalov, Bull. inst. reserches biol. Perm. 11, 25, 1937). Data in gms. per 100 gms. solution at 20° and 50°.

Lower Layer			Temp.	Upper Laver		
Water	Ethanol	Benzene		Water	Ethanol	Benzene
84.0	15.8	0.2	20°	0.5	4.5	95.0
73.0	26.5	0.5		1.0	9.5	89.5
54.0	42.8	3.2		1.3	13.2	85.5
38.0	50.8	11.2		2.8	19.5	77.7
29.5	52.5	18.0		3.3	22.5	74.2
10.0	38.3	51.7			Plait Point	
77.55	21.5	1.0	50°	0	3.0	97.0
66.5	32.0	1.5		0	6.2	93.75
50.5	44.5	5.0		0.7	9.8	89.5
38.5	50.0	11.5		2.0	17.8	80.2
30.5	51.5	18.0		3.0	21.5	75.5
13.5	39.0	47.5			Plait Point	

(W. D. Bancroft and S. J. Hubard, J. Am. Chem. Soc., 64, 347, 1942).

90.6	9.2	0.2	25°	0.1	0.6	99.3
72.0	27.5	0.5		0.55	3.6	95.9
53.9	43.0	3.1		0.9	8.3	90.8
47.0	47.7	5.3		1.3	10.6	88.1
34.1	52.4	13.5		2.1	15.6	82.3
26.4	52.1	21.5		2.9	19.0	78.1
15.8	45.4	38.8		5.2	26.5	68.3

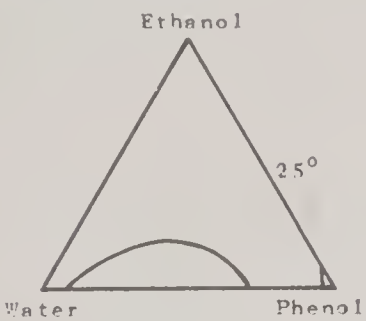
Although the binodal curves are practically coincident, most of these tie lines are much steeper than those of Mochalov at nearly the same temperature. Additional data on this system are given by Bogin (1920), Bonner (1910), Bonner and Williams, J. Phys. Chem., 44, 404 (1940);

TERNARY AQUEOUS SYSTEMS

Holmes (1918); Leikola (1940); Mondain-Monval and Quiquarez (1940). Mossler and Markus, Pharm. Post., 47, 291 (1914). Chem. Abstr. 8, 3216; Ormandy, Pond, and Davies (1934); Othmer and Tobias (1942); Perrakis, Compt. rend., 177, 879 (1923); N. Sata and O. Kimura, Bull. Chem. Soc. Japan, 10, 409 (1935); Chem. Abstr., 30, 350 (one benzene concentration listed there 6.97 should read 26.97%); Spausta, Erdol, und Teer, 8, 282 (1932); Chem. Abstr., 26, 6095; Tarasenkov (1946); Tarasenkov and Paulson (1939); K. A. Vartaressian and M. R. Fenske, Ind. Eng. Chem., 28, 928 (1936); Vlček (1933); A. L. Wilson, Ind. Eng. Chem., 27, 867(1935).

ETHANOL - C_6H_6O, Phenol.

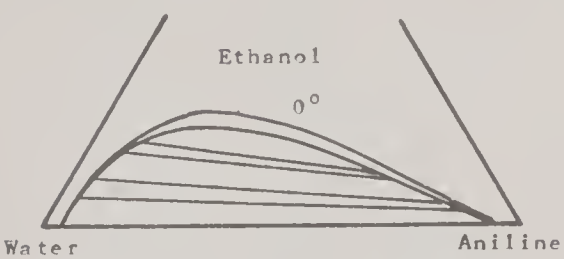
(Schreinemakers, Z. physik. Chem., 29, 599 (1899); Perrakis, Compt. rend. 177, 880, 1923). Compositions in gms. per 100 gms. solution at 25°.



Water	Ethanol	Phenol	Ref.
91.3	0	8.7	II 373
79.9	10.0	10.1	Schreinemakers
44.7	18.6	36.7	Perrakis (20°)
28.9	3.64	67.5	Schreinemakers
28.7	0	71.3	II 373
4.4	0	95.6	II 372
0	7.7	92.3	II 156

The last two items show the equilibrium for solid phenol.

ETHANOL - C_6H_7N, Aniline, $C_5H_5NH_2$. (II 413).



Holmes (1918) gave a single point on the binodal curve at 28.8% water, 23.5% ethanol, 42.7% aniline. The system is discussed also by Mondain-Monval and Quiquarez (1940) and by Ust-Kachkintsev (1937). (D. N. Tarasenkov and A. M. Avenarius, J. Gen. Chem. (U.S.S.R.), 16, 1577, 1946). Data in gms. per 100 gms. solution.

Lower Layer			Temp.	Upper Layer		
Water	Ethanol	Aniline		Water	Ethanol	Aniline
90.3	6.4	3.3	0°	5.3	3.1	91.6
85.6	11.0	3.4		6.3	5.8	87.9
78.6	17.6	3.7		8.3	10.3	81.4
70.1	24.1	5.8		11.2	14.3	74.5
60.33	27.65	12.0		–	–	–
–	–	–		23.67	24.17	52.16
78.0	16.0	6.0	25°	10.6	10.6	78.8
74.8	18.1	7.1		12.3	12.4	75.3
67.05	21.93	11.02		–	–	–
–	–	–		15.75	16.86	67.39
57.30*	24.54	19.16		–	–	–
–	–	–		21.45	20.65	57.90
–	–	–		25.45	22.35	52.20
–	–	–		32.23	23.70	44.07

*This is probably a typographical error for 56.30

TERNARY AQUEOUS SYSTEMS

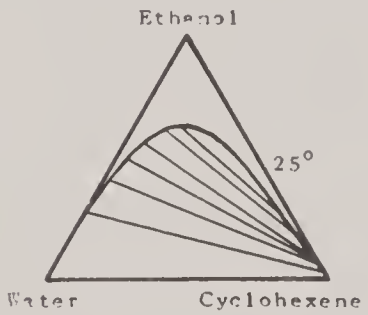
ETHANOL - C_6H_{10}, Cyclohexene.

Washburn, Graham, Arnold, and Transue (1940).

Gms. per 100 gms. Solution at 25°

Lower Layer			Upper Layer (Water negligible)	
Water	Ethanol	Cyclohexene	Ethanol	Cyclohexene
87.4	12.3	0	0.3	99.7
72.3	27.8	0	0.6	99.3
60.0	39.7	0.3	1.0	98.8
49.5	48.7	1.8	1.8	98.0
37.0	58.4	4.6	3.1	96.4
25.6	63.3	11.1	5.9	93.7
19.6	64.3	16.1	7.3	92.4

Kretschmer and Wiebe (1945) presented data from which a few points on the right side can be calculated.

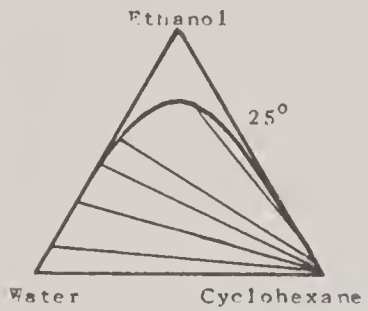


ETHANOL - C_6H_{12}, Cyclohexane (II 149).

Additional data are given by Tarasenkov (1946); Tarasenkov and Paulson (1938, 1939); Ormandy, Pond, and Davies (1934) (see under cyclohexane); and by Kretschmer and Wiebe (1945).

Tie lines observed by Vold and Washburn; Wt. % ethanol in layers.

Aqueous	C_6H_{12}
12.74	0.20
28.10	0.64
43.6	1.20

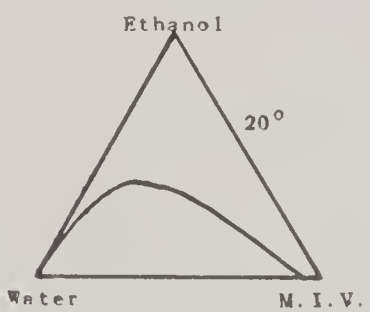


CORRECTION: In middle table of p II 149 change C_6H_{14} to C_6H_{12}.

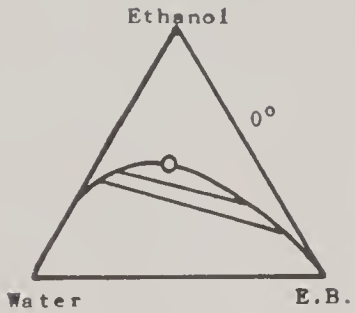
ETHANOL - $C_6H_{12}O_2$, Methyl Isovalerate (II 135).

Pfeiffer's data at 20° recalculated to gms. per 100 gms. solution.

Water	Ethanol	M.I.V.
73.1	24.8	2.1
66.3	30.3	3.4
58.5	35.0	6.5
52.2	37.4	10.4
47.8	38.0	14.2
40.4	38.3	21.3
24.6	35.6	29.8



ETHANOL - $C_6H_{12}O_2$ - Ethyl Butyrate (II 132, 437).



Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	E.B.
55.3	38.6	6.1
48.1	40.5	11.4
46.45	41.0	17.55
35.6	40.8	23.6
32.4	40.1	27.5 P.P.
25.6	38.6	35.8
19.2	36.3	44.5
13.5	32.6	53.9
7.6	24.2	58.2
2.6	14.2	83.2

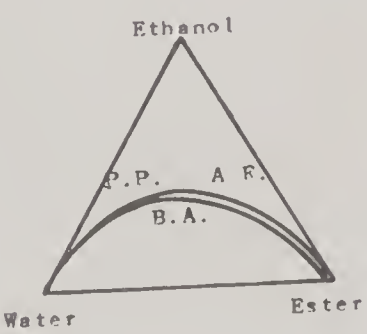
Tie lines: % Ethanol in:

Lower Layer	Upper Layer
35	17
39	25
40.4	34.5
40.9	39.1

The first Sp. Gr. (II 132) should be 0.90 instead of 0.96. Bancroft's data at 20° recalculated to gms. per 100 gms. solution.

Water	Ethanol	E. B.
99.3	0	0.7
69.8	28	2.2
55	37	8
39	39	22
28	38	34
18	35	47
0.5	0	99.5

ETHANOL - $C_6H_{12}O_2$, Propyl Propionate (II 437).



Pfeiffer's data at room temperature recalculated to gms. per 100 gms. solution.

Water	Ethanol	P. P.
72.4	25.8	1.8
66.75	30.4	2.85
60.7	34.45	4.85
50.4	38.7	10.9
45.8	39.4	14.8
38.6	39.3	22.1
23.7	36.0	40.3

TERNARY AQUEOUS SYSTEMS

Butyl Acetate (II 437)

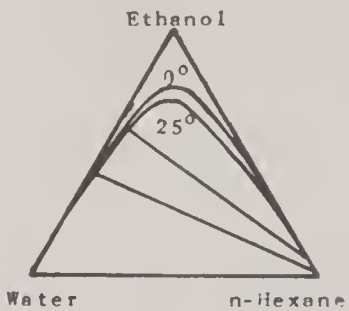
Water	Ethanol	B. A.
67.4	29.6	3.0
63.1	32.4	4.5
58.2	34.2	7.6
51.6	35.4	13.0
44.9	35.5	19.6
29.2	33.6	37.2

Amyl Formate (II 436)

Water	Ethanol	A. F.
71.8	26.4	1.8
63.6	33.1	3.3
58.1	36.2	5.7
53.6	38.0	8.4
47.1	38.7	14.2
26.4	35.0	38.6

ETHANOL - C_6H_{14}, n-Hexane (II 146-8).

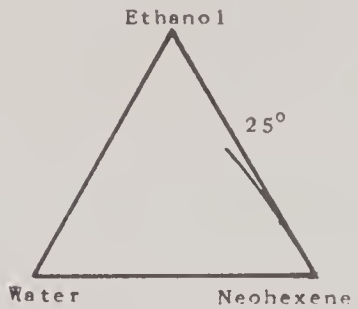
Preference is given to the data of Tarasenkov and Paulson (II 148) over those of Bonner and of Ormandy and Craven, who used impure hexane.



ETHANOL - C_6H_{14}, 2,2-Dimethylbutane or Neohexane.

(Kretschmer and Wiebe, 1945). Data recalculated to gms. per 100 gms. solution.

Temp.	Water	Ethanol	Neohexane
-45	0.22	12.0	87.8
	0.78	28.7	70.5
	2.2	53.9	43.9
0	0.48	11.9	87.6
	1.62	28.6	69.8
	4.2	52.8	43.0
25	0.67	11.9	87.4
	2.21	28.6	69.2
	5.3	52.3	42.4

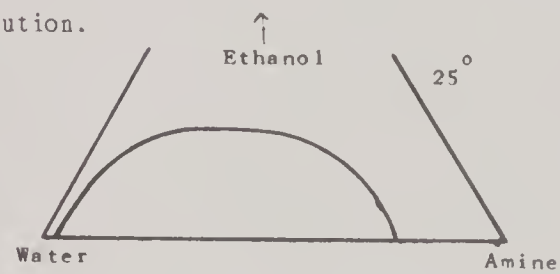


ETHANOL - $C_6H_{15}N$, Di-n-Propyl Amine, $(C_3H_7)_2NH$.

(R. W. Hobson, R. J. Hartman, and E. W. Kanning, J. Am. Chem. Soc., 63, 2094, 1941).

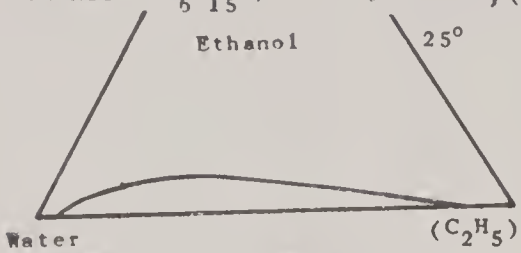
Data in gms. per 100 gms. solution.

Water	Ethanol	Amine
95.7	0	4.3[a]
78.1	17.5	4.4
69.0	21.6	9.4
61.4	23.7	14.9
54.3	25.1	20.6
43.9	26.2	29.9
35.7	26.4	37.9
30.8	23.6	45.6
26.55	19.0	54.5
22.8	10.0	67.2
20.6	1.8	77.6
21.2	0.0	78.8[a]



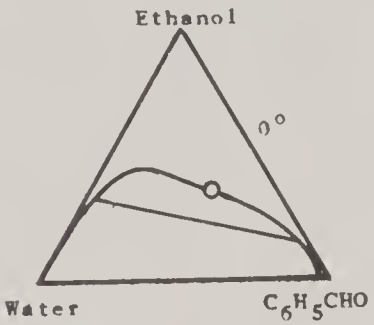
(a) Interpolated from data on the binary system, water-di-n-propyl amine. This system has a lower critical solution temperature at -4.8° with 33.69% amine by weight.

ETHANOL - $C_6H_{15}N$, Triethyl Amine, $(C_2H_5)_3N$ (II 467).



The graph is interpolated from the data of Meerburg. The apex of the curve at 25° is at about 8% ethanol.

ETHANOL - C_7H_6O, Benzaldehyde, C_6H_5CHO (II 142).



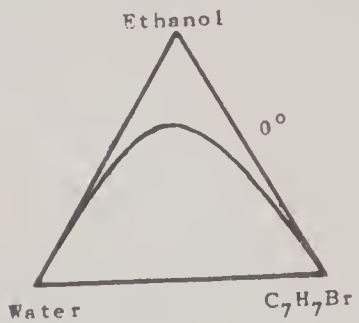
Tie lines: Wt. % ethanol in layers

Aqueous	Benzaldehyde
30	13
40.5	26
40.8	33

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Benzaldehyde	
66.4	31.5	2.1	
55.9	37.9	6.2	
47.9	40.1	12.0	
41.3	41.2	17.5	
36.0	40.6	23.4	
30.6	39.2	30.2	
26.7	37.9	35.4	P.P.
19.4	35.5	45.1	
14.1	29.6	56.4	
7.9	22.0	70.1	
3.7	13.7	82.6	

ETHANOL - C_7H_7Br, Bromotoluene (II 144, 542)



Bonner's data at 0° recalculated to gms. per 100 gms. solution. The isomer is not identified, but it cannot contain much of the para (M.P. 28.5°). It is probably mostly ortho.

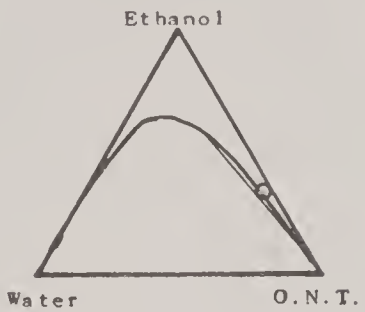
Water	Ethanol	C_7H_7Br
41.9	56.7	1.4
35.6	60.5	3.9
28.8	61.8	9.4
24.2	65.4	10.4
17.8	64.4	17.8
11.8	60.6	27.6
8.8	56.1	35.1
5.3	46.5	48.2
3.2	34.3	62.5
1.5	24.8	73.7

Some data for tie lines are given, but they are all so steep that they practically radiate from the bromotoluene corner.

ETHANOL - $C_7H_7NO_2$. o-Nitrotoluene (II 144).

In three tables Bonner called this substance "p-nitrotoluene", and it is so quoted in II 144, in Int. Crit. Tables, and in other compilations. However, in his preparation Bonner called it "ortho", which it must have been. The para isomer melts at 52°, the meta at 16°, and the ortho at -10.5°. Bonner's data are recalculated to gms. per 100 gms. solution.

Water	Ethanol	ONT	
44.8	52.5	2.7	
39.2	56.5	4.3	
30.4	62.0	7.6	
25.1	64.5	10.4	
21.0	65.9	13.9	
14.7	63.3	22.0	
11.7	61.1	27.2	
8.7	56.3	35.0	
5.7	45.7	48.9	
3.3	33.3	63.4	P.P.
1.8	20.2	78.0	



Tie lines: Wt. % Ethanol in layers

Aqueous	ONT
45.7	19.5
40.7	24

ETHANOL - C_7H_8. Toluene (II 142-4).

CORRECTION: On p II 143, middle table, column 7, change C_6H_5OH to C_2H_5OH.

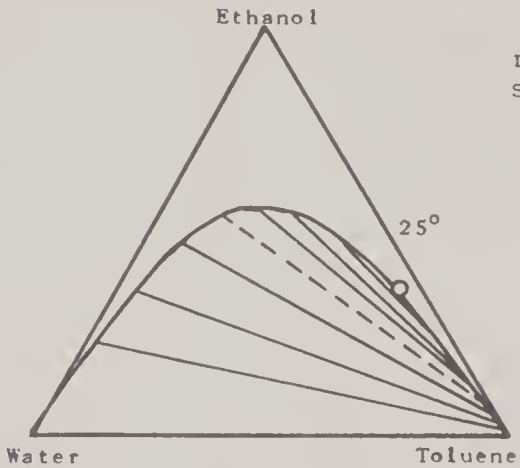
This system contains an isopycnic (tie line for liquid phases of equal density) (dashed line in the graph) at 0°, 20°, 25° though Washburn and coworkers (II 143) did not note it. There is no isopycnic at 40°. Tie lines: Wt. % ethanol in layers at 25°. Washburn, Beguin, and Beckford, J. Am. Chem. Soc., 61, 1694 (1939).

Aqueous	Toluene	Aqueous	Toluene	
11.0	0.2	46.9	5.3	
19.2	0.7	50.0	6.5	
25.7	1.3	53.3	8.7	
35.2	2.7	55.6	9.4	
41.7	4.7	37.0	37.0	Plait Pt. (8.4% water)

Mondain-Monval and Quiquarez (1940).

Aqueous Layer			Toluene Layer			
Water	Ethanol	Toluene	Water	Ethanol	Toluene	Layer
77.9	22.0	0.1	-	1.0	99.0	Upper
63.6	35.5	0.9	0.1	3.4	96.5	"
49.1	48.0	2.9	0.3	4.1	95.6	"
32.3	56.6	11.1	1.0	11.5	87.5	"
23.6	56.4	20.0	1.9	15.1	83.0	"
17.3	53.5	28.7	2.0	16.8	81.2	"
12.5	46.0	41.5	4.5	25.5	70.0	Lower
7.7	35.3	57.0	Plait Point			

ETHANOL

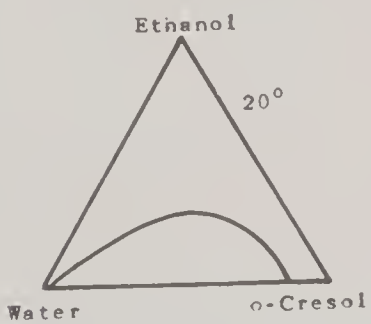


Leikola's data at 20-21° (1940) recalculated to gms. per 100 gms. solution.

Water	Ethanol	Toluene
43.6	51.3	5.1
32.2	56.5	11.3
25.7	57.2	17.1
18.7	54.2	27.1
14.8	50.1	35.1
11.4	44.3	44.3
8.1	36.8	55.1
5.9	31.4	62.7

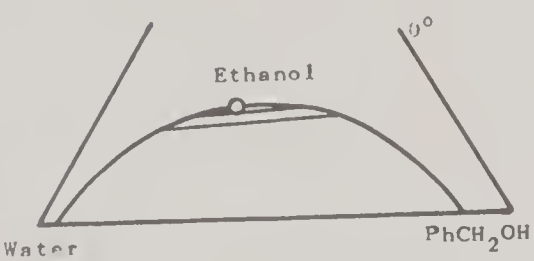
Additional data on this system are given by Curtis (1898); Ormandy, Pond, and Davies (1934) (see under Toluene); Sata and Kimura (1935); Tarasenkov and Paulson (1939); Tarasenkov (1946).

ETHANOL - C_7H_8O, o-Cresol.



Perrakis (1923) gave one point on the curve 20.6% water, 26.4% ethanol, and 53% o-Cresol by weight. The extremities of the curve result from data on p. II 547.

ETHANOL - C_7H_7O, Benzyl Alcohol $C_6H_5CH_2OH$ (II 141).



Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	$C_6H_5CH_2OH$
84.3	12.2	3.5
66.7	25.9	7.4
58.0	28.0	14.0
49.6	29.1	21.3
43.6	29.6	26.8
35.7	28.6	35.7
28.8	28.0	43.2
22.2	26.0	51.8
15.9	20.6	63.5
8.9	11.5	79.6

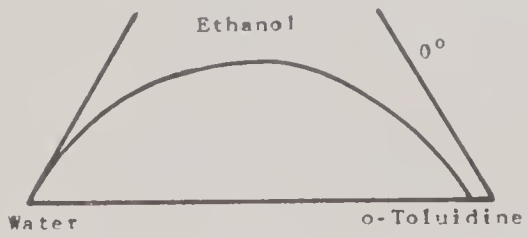
Tie lines: Wt. % ethanol in layers.

Aqueous	$C_6H_5CH_2OH$
22	26.6
27.5	28.1

ETHANOL - C_7H_9N, o-Toluidine (II 144).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Toluidine
77.1	20.8	2.1
61.7	31.6	6.7
53.7	32.9	13.4
46.7	33.3	20.0
40.0	33.3	26.7
33.8	32.4	33.8
27.5	31.3	41.2
21.3	29.1	49.6
15.2	24.3	60.5
8.3	17.3	74.4
4.5	2.4	93.1

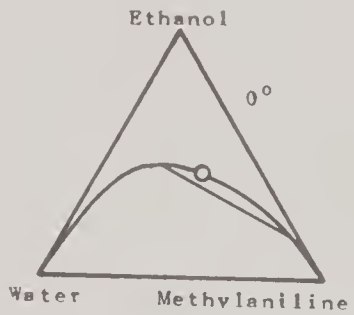


Bonner gave no tie lines. They would be somewhat steeper than in the case of aniline (down toward the right). Mondain-Monval and Quiquarez (1940a) observed that the binary system water-o-toluidine has an isopycnic at 24.5°, so that this ternary system would have one above that temperature but not below. In this case the isopycnic is near the base line instead of near the plait point, as it usually is.

ETHANOL - C_7H_9N, Methylaniline, $C_6H_5NHCH_3$ (II 142).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Methylaniline	
60.6	36.8	2.6	
52.0	42.3	5.7	
42.8	46.5	10.7	
36.7	47.6	15.7	
31.8	47.0	21.2	
22.7	43.2	34.1	
19.8	41.8	38.4	P.P.
13.2	35.7	51.1	
7.3	27.0	65.7	
3.4	17.9	78.7	



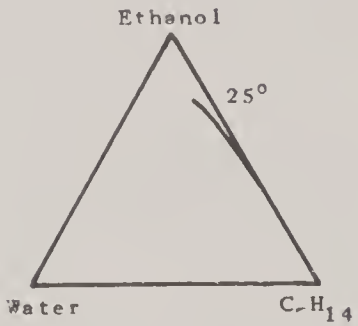
Tie lines: Wt. % Ethanol in layers.

Aqueous	Methylaniline
46.9	20
46.3	29
43.8	37

Above 2° this system has an isopycnic or tie line (near the base line) connecting phases of equal density.

ETHANOL - C_7H_{14}, Methylcyclohexane.

Data of Kretschmer and Wiebe (1945) recalculated to gms. per 100 gms. solution.

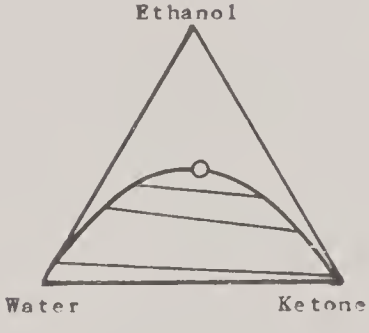


Temp.	Water	Ethanol	C_7H_{14}
-45	0.39	25.5	74.1
	1.25	62.8	36.0
	4.06	72.6	23.3
0	1.02	25.3	73.7
	2.84	62.0	35.2
	7.0	70.4	22.6
25	1.57	25.2	73.2
	4.0	61.1	34.9
	8.8	69.0	22.2

Although only a portion of the binodal curve results from the data, it should include the plait point. This would have been indicated if in adding small quantities of water to the ethanol hydrocarbon mixture a small upper layer had resulted. The authors did not note this observation.

ETHANOL - $C_7H_{14}O$, Di-n-propyl Ketone.

Othmer, White, and Trueger (1941) (See note under ethanol-n-amyl alcohol). Concentrations in gms. per gms. solution at 25-6°.



Lower Layer			Upper Layer		
Water	Ethanol	Ketone	Water	Ethanol	Ketone
99.7	0	0.32	0.99	0	99.0
97.5	2.11	0.38	1.24	1.25	97.5
90.8	8.62	0.54	1.77	3.93	94.3
79.1	19.9	1.01	-	-	-
68.4	29.3	2.27	6.5	21.0	72.5
52.6	38.5	8.9	16.0	34.5	49.5
38.3	41.1	20.6	-	-	-
-	-	-	27.1	39.5	33.4

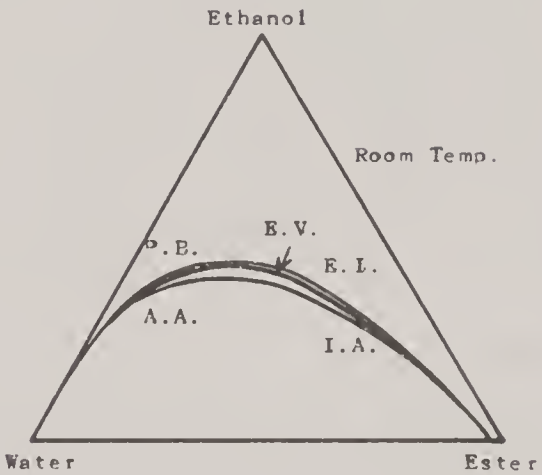
ETHANOL - $C_7H_{14}O_2$ (II 565).

Pfeiffer's and Bancroft's data recalculated to gms. per 100 gms. solution at room temperature.

Water	Ethanol	Ester	Water	Ethanol	Ester
n-Amyl Acetate			Isoamyl Acetate		
62.5	34.1	3.4	61.6	35.2	3.2
58.1	36.3	5.6	56.5	37.7	5.8
54.5	37.4	8.1	49.3	39.5	11.2
48.0	38.2	13.8	35.3	39.2	25.5
26.1	35.5	38.5	28.7	38.1	33.2
			23.7	36.6	39.7

Pfeiffer's and Bancroft's data (Con.)

Water	Ethanol	Ester
Propyl Butyrate		
61.7	36.1	2.2
54.7	40.8	4.5
48.2	43.8	8.0
42.5	45.1	12.4
38.5	45.0	16.5
32.3	43.7	24.0
19.2	38.5	42.3
Ethyl-n-Valerate		
72.7	26.2	1.06
65.1	33.0	1.9
61.1	35.9	3.0
56.6	38.7	4.7
49.2	41.7	9.1
22.0	37.2	40.8
Ethyl Isovalerate		
70.8	28.3	0.9
65.6	32.8	1.6
57.8	38.4	3.8
52.0	41.5	6.5
44.1	44.1	11.8

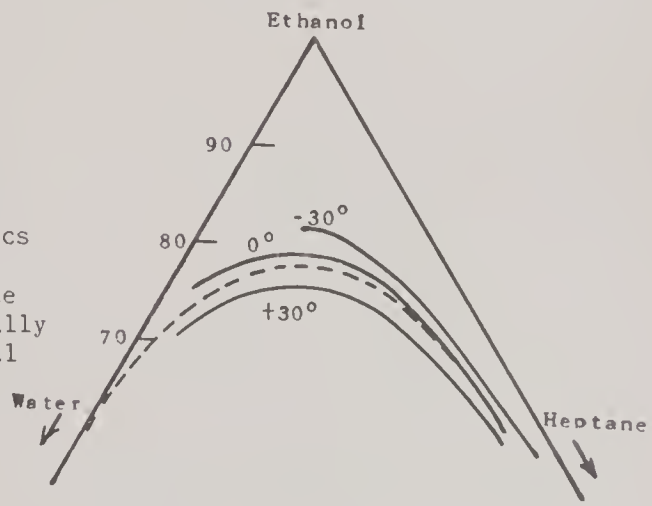


ETHANOL - C_7H_{16}, n-Heptane (II 147, 148, 562).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Heptane
27.4	69.8	2.8
20.3	74.8	4.9
14.4	76.0	9.6
7.9	73.8	18.3
4.1	70.3	23.6
2.2	41.4	56.4

These data are very consistent. The difference, which Ormandy and Craven thought was due to aromatics in Bonner's heptane is trifling. Neither investigation reported tie lines, which would point practically to the heptane corner. Additional results at 15° are reported by Ormandy, Pond, and Davies (1935) (see under Heptane). These also are consistent.



TERNARY AQUEOUS SYSTEMS

ETHANOL

CORRECTION: The table at the top of p. II 148 should be entitled "Reciprocal Solubility as Liquids of....". The column headings should be "Temperatures" instead of "F. pt.", and the footnote should read "miscibilities" instead of "freezing points".

Temp.	Water	Ethanol	Heptane
30°	17.5	72.1	8.30
	12.0	73.75	14.25
	0.1	70.0	10.05
	2.4	50.6	30.00
	1.42	20.2	00.42
	0.10	8.00	01.18

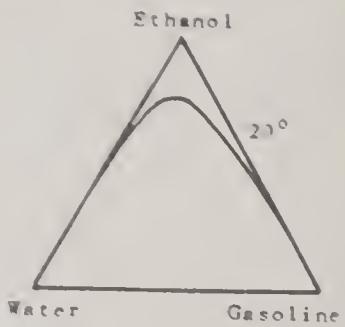
Ormandy and Craven's data recalculated to same basis.

Temp.	Water	Ethanol	Heptane
-30°C	0.6	81.5	8.02
	0.0	78.8	15.24
	4.3	75.1	20.50
	1.8	58.0	30.31
	0.74	40.07	59.10
	0.10	8.9	00.07
0°	13.4	78.1	8.50
	8.23	70.35	15.42
	0.42	73.81	10.75
	2.63	58.75	38.61
	1.27	30.05	58.78
	0.10	0.25	00.50

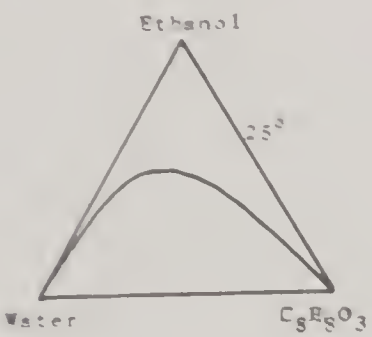
ETHANOL - Gasoline (I 588, II 150-2, 833).

CORRECTION: In the title of the table at the top of p. II 152 "Ethyl Alcohol" should be proceeded by "66%".

Additional data on this system are given by Crismer, Bull. soc. chim. Belg. 18, 18 (1904); Vandam, ibid., 20, 374 (1906); Bogin (1924); Ormandy, Pond, and Davies (1934); Mondain-Monval and Quiquarez (1934-5); Koo and co-workers, Ind. Research (China) 3, 112 (1934); 5, 101 (1936); N. V. Ershov and E. A. Meerzon, J. Applid. Chem., 12, 50 (1939); Chem. Abstr., 33, 9557; and E. Aldrich, J. Res. Natl. Bur. Standards, 20, 0 (1938).



ETHANOL - $C_8H_8O_3$, Methyl Salicylate, o-$HOC_6H_4COOCH_3$. (II 592-3).



Seidell's data at 25° recalculated to gms. per 100 gms. solution.

Water	Ethanol	$C_8H_8O_3$
00.0	20.8	0.0
58.6	30.1	2.3
40.0	40.0	0.2
20.5	20.5	10.0
32.0	18.8	18.0
24.3	45.2	30.5
18.2	42.3	39.5
10.4	31.1	58.5
5.0	22.4	72.0

No tie lines are given, but the shape of the curve indicates that they would slope down toward the right.

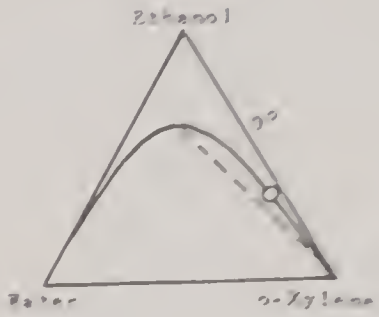
TERNARY AQUEOUS SYSTEMS

ETHANOL - XYLENES

ETHANOL - C_8H_{10}, o-Xylene (II 145).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	o-Xylene
44.2	54.4	1.4
28.5	64.4	7.1
20.3	66.2	13.5
14.7	63.2	22.1
10.9	57.1	33.9
2.6	34.6	62.8 D.P.
2.1	26.9	71.9



This system has an isodynamic, termed tie line, connecting liquid phases of equal density. Its position is estimated.

ETHANOL - C_8H_{10}, m-Xylene (II 145)

Since no tie lines are given by Bonner, nor by Ormandy and Craven (mixed xylenes), the graph is drawn from the more recent data of Morales-Monval and Orejuarez (1940) in gms. per 100 gms. solution at 25°.

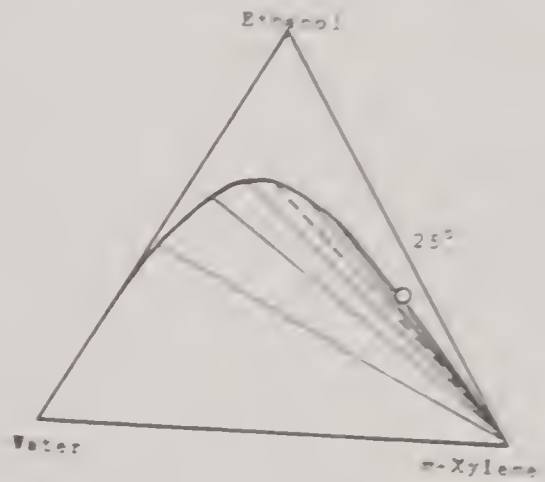
Water	Ethanol	m-Xylene	Density	Water	Ethanol	m-Xylene	Density
52.0	47.0	1.0	0.9172	0.2	2.3	97.5	0.8720
34.3	59.1	6.6	.8767	0.3	7.0	92.7	.8763
24.6	62.1	13.3	.8582	0.7	9.1	90.2	.8722
17.0	59.0	23.5	.8483	1.2	12.1	86.7	.8702
12.5	57.3	28.2	.8431	1.1	15.8	83.7	.8692
12.1	53.9	34.0	.8412	2.4	20.6	77.0	.8666
6.2	36.2	57.6			Plait Point.		

The densities indicate an isodynamic as shown in the graph by a dashed line.

ETHANOL - m Xylene (cont.).

Leibola (1940)

Water	Ethanol	m-Xylene
34.9	59.2	5.9
25.0	62.5	12.5
19.7	61.8	18.5
13.8	57.5	28.7
8.4	45.8	45.8
4.6	31.8	63.6



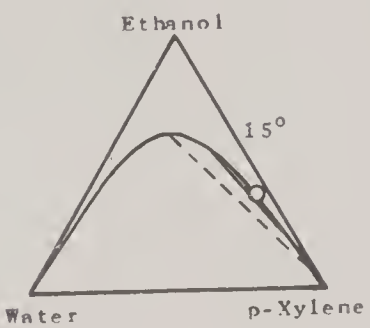
ETHANOL - m-Xylene (cont.)-

Mochalov (1937). Gms. per 100 gms. solution at 0° and 50°.

Temp.	Aqueous Layer			Xylene Layer		
	Water	Ethanol	Xylene	Water	Ethanol	Xylene
0	70.5?	30.4	-	-	0.9	99.0
	47.5?	51.7	0.3	0.1	2.4	97.5
	32.5	63.8	3.7	0.2	4.1	95.7
	19.0	69.7	11.3	0.2	8.8	91.0
	3.5	40.5	56.0		Plait Point	
50	79.5	20.3	0.2	-	3.2	96.7
	61.7	37.8	0.5	-	6.0	93.8
	49.0	49.5	1.5	0.4	7.6	92.0
	38.0	57.0	5.0	0.8	10.2	89.0
	25.0	62.3	12.7	1.0	13.0	86.0
	19.2	61.3	19.5	1.2	15.3	83.5
	7.5	40.5	52.0		Plait Point	

ETHANOL - p-Xylene (II 145).

Because of the m.p. of p-xylene, Bonner's observations on this isomer were made at 15° instead of 0° as listed in II 145 and in International Critical tables. They are recalculated to gms. per 100 gms. solution.



Water	Ethanol	p-Xylene	
52.8	46.4	0.8	
37.6	58.2	4.2	
30.7	62.0	7.3	
21.6	64.0	14.4	
12.8	57.4	29.8	
9.8	51.2	39.0	
5.1	36.3	58.6	P.P.
2.6	23.4	74.0	

This system also has an isopycnic (dashed line) whose position is only estimated.

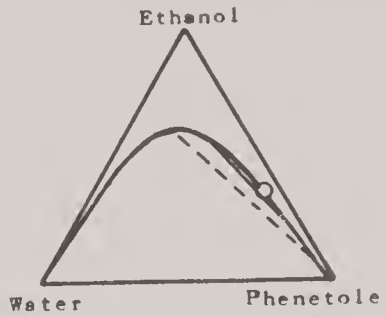
Tie lines: Wt. % Ethanol in layers

Aqueous	Xylene
46	20
44	25

ETHANOL - $C_8H_{10}O$ - Phenetole, $C_6H_5OC_2H_5$ (II 142).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Phenetole	
42.6	53.6	3.8	
32.8	59.1	8.1	
23.5	60.9	15.6	
16.7	58.2	25.1	
10.5	47.8	41.7	
6.5	35.5	58.0	P.P.
1.6	13.6	84.8	



CORRECTION: On p. II 142, first item under Phenetole should be 0.982 and 0.018 instead of 0.992 and 0.18.

Tie lines: Wt. % ethanol in layers.

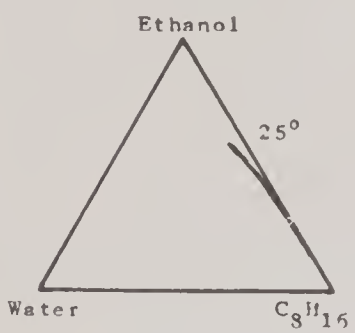
Aqueous	Phenetole
52	11
45	19
42	24

This system has an isopycnic (dashed line) or tie line connecting compositions of phases of equal density.

ETHANOL - C_8H_{16}, Diisobutene, $Me_3CCH{:}CMe_2$ and $Me_3CCH_2CH(Me){:}CH_2$.

Kretschmer and Wiebe (1945). Data recalculated to gms. per 100 gms. solution.

Temp.	Water	Ethanol	C_8H_{16}
-45	1.1	26.8	72.1
	2.5	51.3	46.2
0	1.9	26.5	71.6
	4.4	50.4	45.2
25	2.4	26.4	71.2
	5.6	49.7	44.7



Separate data are given for "iso-octene" b.p. 80-170°.

See note under ethanol-methylcyclohexane.

ETHANOL - C_8H_{16}, Dimethylcyclohexane or Hexahydroxylene (II 607).

A single point on the binodal curve, 5.9% water, 67.7% ethanol, 26.4% C_8H_{16} is given.

ETHANOL - C_8H_{18}, 2,2,4-Trimethylpentane or Isooctane, $Me_3CCH_2CHMe_2$.

Kretschmer and Wiebe (1945). Data recalculated to gms. per 100 gms. solution. Graph similar to that for ethanol-diisobutene above.

Temp.	Water	Ethanol	C_8H_{18}	Temp.	Water	Ethanol	C_8H_{18}
-45	0.13	11.2	88.7	0	2.6	52.2	45.2
	0.4	27.7	71.9		6.4	71.9	21.7
	1.2	53	45.8	25	0.5	11.2	88.3
	3.5	74.5	22.0		1.5	27.3	71.2
0	0.3	11.2	88.5		3.8	51.3	44.9
	1.0	27.5	71.5		8.1	70.7	21.2

See note under ethanol-methylcyclohexane.

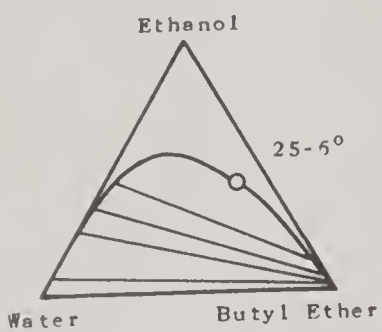
ETHANOL - C_8H_{18} - n-Butyl Ether $(C_4H_9)_2O$.

Othmer, White, and Trueger (1941). See note under ethanol-n-amyl alcohol, p. 916. Data in gms. per 100 gms. solution.

Aqueous Layer			Butyl Ether Layer		
Water	Ethanol	$C_8H_{18}O$	Water	Ethanol	$C_8H_{18}O$
99.9	0	0.08[a]	0.10	0	99.9
93.66	5.23	0.11	0.18	0.61	99.2
74.4	25.3	0.27	0.52	3.27	96.1
67.95	31.6	0.45	0.84	6.93	92.2
57.3	41.6	1.11	1.4	11.68	86.9
-	-	-	2.74	16.6	80.7
32.2	55.8	12.0	-	-	-
-	-	-	5.97	27.4	66.7
21.2	51.6	27.2	-	-	-
13.0	41.3	45.7	-	-	-

(a) cf. II 622.

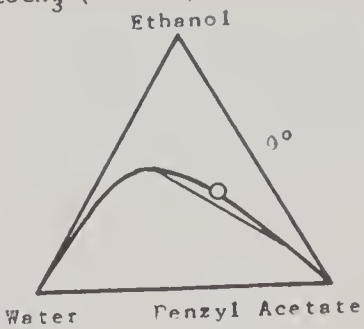
Additional data are given by Drouillon, J. chim. phys. 22, 149 (1925).



ETHANOL - $C_9H_{10}O_2$, Benzyl Acetate, $C_5H_5CH_2OCOCH_3$ (II 141).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Benzyl Acetate	
57.6	39.9	2.5	
50.0	44.5	5.5	
42.5	46.8	10.7	
32.4	46.0	21.6	
28.1	43.8	28.1	
20.0	37.5	42.5	P.P.
13.7	31.5	54.8	
7.5	24.1	68.4	
2.1	10.7	87.2	



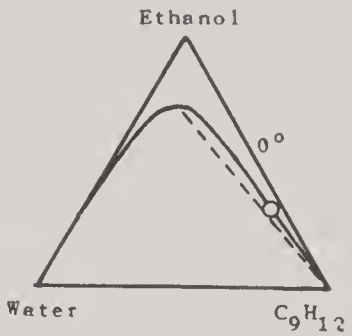
Tie lines: Wt. % ethanol in layers.

Aqueous	Benzyl Acetate
46.8	12
45.5	25
42.9	29

ETHANOL - C_9H_{12}, Mesitylene, $C_6H_3(CH_3)_3$ (1,3,5). (II 136).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	C_9H_{12}	
36.4	61.6	2.0	
27.5	69.4	3.1	
19.0	72.9	8.1	
14.2	71.6	14.2	
9.9	67.1	23.0	
4.8	52.2	43.0	
2.0	32.4	65.6	P.P.



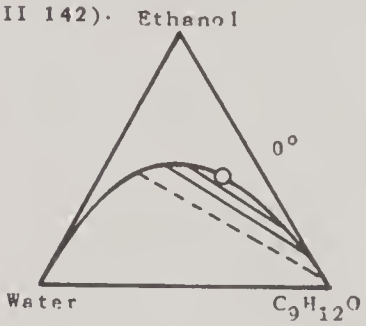
The system has an isopycnic (dashed line) or tie line connecting compositions of equal density.

ETHANOL - $C_9H_{12}O$, Benzyl Ethyl Ether (II 142).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	$C_9H_{12}O$	
51.3	44.2	4.5	
41.1	48.7	10.2	
35.7	49.0	15.3	
26.7	46.6	26.7	
19.3	41.5	39.2	P.P.
13.0	35.0	52.0	
7.3	27.0	65.7	
2.4	15.9	81.8	

This system also has an isopycnic.



Tie lines: Wt. % ethanol in layers

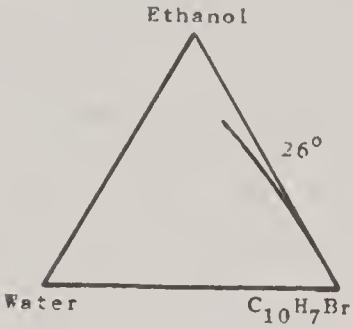
Aqueous	Ether
49	16
47	31

TERNARY AQUEOUS SYSTEMS

ETHANOL

ETHANOL - $C_{10}H_7Br$, α-Bromonaphthalene.

The headings of the table in International Critical Tables III 405-6 are misleading. Instead of "100 g. aqueous B" read "1.0 g. aqueous B"; instead of "opaque" read "translucent"; instead of "by weight of B" read "by weight of A"; and instead of "0.4074" read "0.3981". Thus recalculated data are as follows in gms. per 100 gms. solution at 26°.



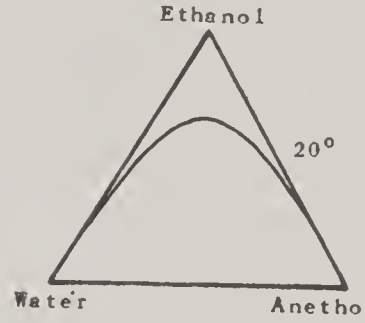
Water	Ethanol	$C_{10}H_7Br$
7.34	64.2	28.5
5.65	61.0	33.4
4.32	57.0	38.7
3.29	52.4	44.3
2.50	47.5	50.0
1.93	42.4	55.7
1.54	37.2	61.3

This portion of the binodal curve undoubtedly includes the plait point, but no data are given to locate it.

ETHANOL - $C_{10}H_7NO_2$, α-Nitronaphthalene (II 647).

Data are inadequate for a ternary diagram. Only data along one isogous line, toward 95% ethanol (probably by volume) are given.

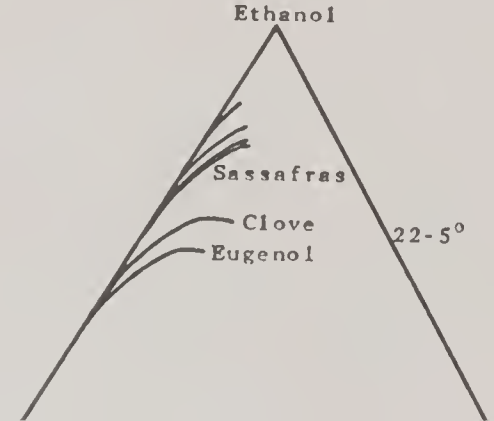
ETHANOL - $C_{10}H_{12}O$, Anethol (p-Propenylanisole), n-$C_3H_5C_6H_4OCH_3$ (II 668).



Data at 20° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Anethol
57.35	42.4	0.25
10.2	61.2	28.6

ETHANOL - $C_{10}H_{12}O_2$, Eugenol, $C_3H_5C_6H_3(OH)OCH_3$ (II 832).



Wood's data at 22-5° recalculated to gms. per 100 gms. solution.

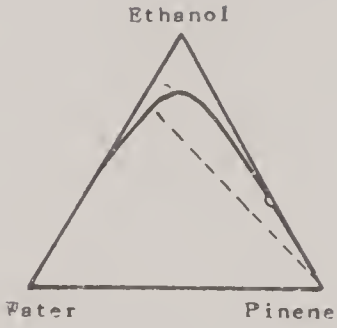
Water	Ethanol	Eugenol
65	34.7	0.3
52	41.6	6.4
38.1	45.7	16.2

Similar data are given for five other vegetable oils showing higher curves in the order, clove oil, sassafras oil, cinna-

ETHANOL – $C_{10}H_{16}$, Pinene (II 144).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Pinene	
36.5	62.2	1.3	
27.2	70.0	2.8	
17.5	75.2	7.3	
12.3	75.8	11.9	
8.2	72.7	19.1	
4.0	61.4	34.6	
1.0	32.0	67.0	P.P.
0.8	21.0	78.2	



The system has an isopycnic (dashed line) or tie line connecting compositions of equal density

ETHANOL - Turpentine (II 837).

Data are inadequate for a complete isotherm.

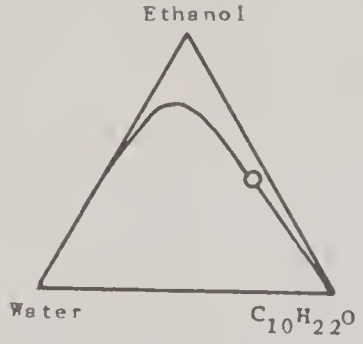
ETHANOL - 'Paraffin Oil' (b. pt. 160-180°) (II 152) presumably mostly decanes.

Howard and Patterson obtained their ethanol by "purifying and dehydrating 99.5% alcohol". The observed critical solution temperature, 33.5° is nearly 50° higher than might be expected from other data on pure hydrocarbons. They showed the effects of small amounts of water on mutual miscibility.

ETHANOL – $C_{10}H_{22}O$, Isoamyl Ether (II 136).

Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Ether	
31.4	65.1	3.5	
21.5	69.2	9.3	
16.8	66.4	16.8	
11.6	61.1	27.3	
9.1	54.5	36.4	
6.3	42.5	51.2	P.P.
3.1	26.9	70.0	

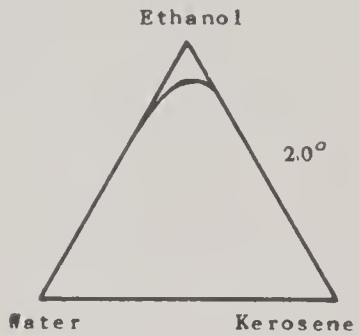


Tie lines: Wt. % ethanol in layers.

Aqueous	Ether
57	19
53	27

ETHANOL - $C_{11}H_{16}$, Butyltoluene.

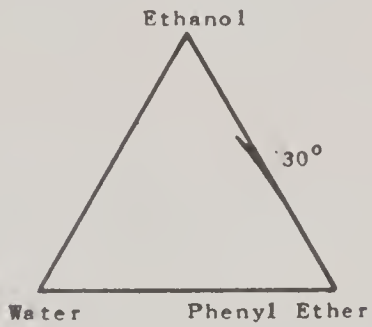
ETHANOL - Kerosene.



Bogin (1924) presented a curve from which the following compositions in gms. per 100 gms. solution are calculated:

Water	Ethanol	Kerosene
7.5	86.5	6
3.5	87.5	9
1	85	14

ETHANOL - $C_{12}H_{10}O$, Diphenyl Oxide or Phenyl Ether (II 145).

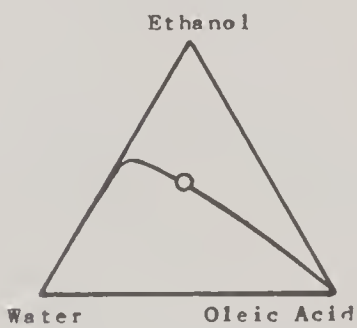


Perrakis' data at 30° are recalculated to gms. per 100 gms. solution.

Water	Ethanol	Phenyl Ether
0.57	13.1	86.3
1.53	28.0	70.5
2.29	35.8	61.9
2.95	41.9	55.15
3.75	48.7	47.5

ETHANOL - $C_{13}H_{10}O$ Benzophenone (II 722).

ETHANOL - $C_{18}H_{34}O_2$, Oleic Acid (II 784-5).



Seidell's data at 25° recalculated to gms. per 100 gms. solution.

Water	Ethanol	Oleic Acid
37.8	58.7	6.5
33.1	51.7	15.2
23.3	44.3	32.4
15.2	35.9	48.9
3.07	11.4	85.5

From the relative volumes of the layers on separation the plait point is at about 22% oleic acid.

ETHANOL - $C_{57}H_{104}O_6$, Triolein or Olive Oil (II 150).

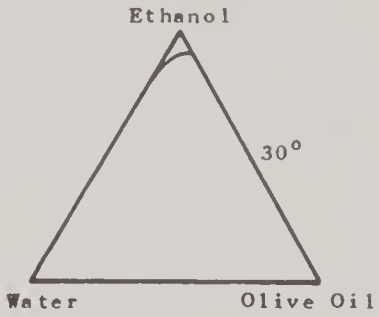
Distribution coefficient.

ETHANOL - Cottonseed Oil.

(Harris, Bishop, Lyman, and Helpert, 1947). (cf. II 150).

Data read from curve, probably in gms. per 100 gms. solution at 30°.

Water	Ethanol	Oil
8	91	1
5	93	2
3	94	3
1	94	5

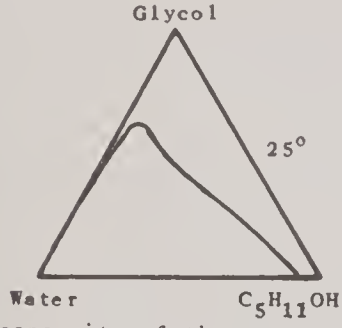


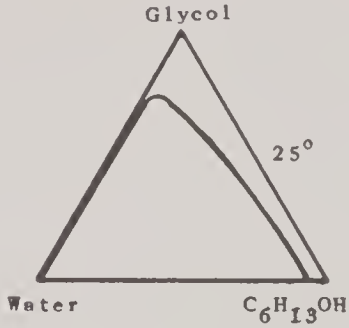
ETHYLENE GLYCOL - $C_2H_6O_2$, $C_5H_{12}O$, n-Amyl Alcohol.

(G. S. Laddha and J. M. Smith, 1948).

Compositions in gms. per 100 gms. solution at 25°.

Lower Layer			Upper Layer		
Water	Glycol	$C_5H_{11}OH$	Water	Glycol	$C_5H_{11}OH$
98.5	0.0	1.5	8.9	0.0	91.1
82.1	16.4	1.5	9.0	1.9	89.1
66.1	32.1	1.8	9.5	5.8	84.7
52.8	44.9	2.3	10.1	9.6	80.3
38.5	58.1	3.4	12.1	18.0	69.9





The concavity of the curve at the position of the plait point has been questioned. It might be due to a trace of hydrocarbon in the alcohol.

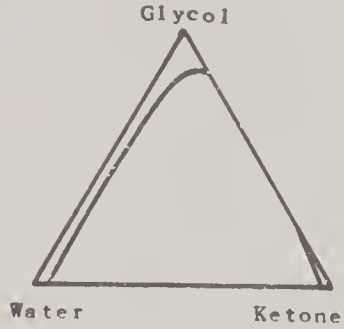
Ethylene Glycol – Furfural See p. 1008

ETHYLENE GLYCOL - $C_6H_{14}O$, n-Hexyl Alcohol.

(Laddha and Smith, 1948). Compositions in gms. per 100 gms. solution at 25°.

Lower Layer			Upper Layer		
Water	Glycol	$C_6H_{13}OH$	Water	Glycol	$C_6H_{13}OH$
99.5	0.0	0.5	5.7	0.0	94.3
78.5	21.1	0.5	5.8	2.5	91.7
69.9	29.5	0.6	5.8	3.0	91.2
59.3	40.0	0.7	5.9	3.6	90.5

ETHYLENE GLYCOL - $C_7H_{14}O$, Methyl n-Amyl Ketone and C_8H_{10}, o-Xylene



E. G. Scheibel, Ind. Eng. Chem. 42, 1947 (1950).

Distribution of water and ethanol between glycol and these two liquids. No temperature and no numerical data.

C_2H_7N, Dimethyl Amine, $(CH_3)_2NH$. (II 160).

Distribution between water and chloroform, ether, benzene, toluene, or xylene; and between glycerol and acetone.

C_2H_7N, Ethyl Amine, $C_2H_5NH_2$ (II 161-2).

Distribution between water and chloroform, ether, toluene, or xylene; and between glycerol and acetone. The last is solutropic (with a horizontal tie line).

C_3H_3N, Acrylonitrile, CH_2:CH-CN.

Distribution between water and styrene, $C_6H_5CH:CH_2$ at 25° and 60°. W. V. Smith, J. Am. Chem. Soc., 70, 2178 (1948).

$C_3H_3O_2N$, Cyanoacetic Acid, $CNCH_2COOH$ (II 164).

Distribution between water and ether or benzene.

C_3H_4O, Acrolein, CH_2:CHCHO (II 165).

Effects of hydroquinone and gallic acid on critical solution temperature with water.

$C_3H_4O_2Br_2$, $\alpha\beta$-Dibromopropionic Acid, $CH_2BrCHBrCOOH$ (II 165).

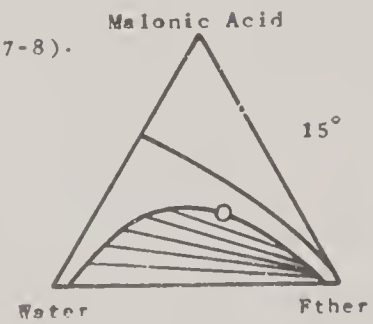
Distribution between water and chloroform, ether, or xylene.

$C_3H_4O_3$, Pyruvic Acid, $CH_3COCOOH$ (II 166).

Distribution between water and chloroform, ether, or xylene.

$C_3H_4O_4$,- Malonic Acid, $CH_2(COOH)_2$ (II 167-8).

Distribution between water and ether, isobutanol, n-amyl alcohol, isoamyl alcohol.



C_3H_5OCl - Epichlorohydrin, $\underline{CH_2O}CHCH_2Cl$ (II 102, 103, 108)

See Acetic Acid p. 886

$C_3H_5O_2Br$, α Bromopropionic Acid $CH_3CHBrCOOH$ (II 170-1).

Distribution between water and chloroform, ether, benzene, toluene, xylene, or olive oil.

$C_3H_5O_2Br$, β Bromopropionic Acid, CH_2BrCH_2COOH (II 170-1).

Distribution between water and chloroform, benzene, toluene or olive oil.

$C_3H_5O_2Cl$, β-Chloropropionic Acid, (II 171). Distribution between chloroform, ether, benzene, toluene, xylene.

$C_3H_5O_2I$, β-Iodopropionic Acid, (II 172). Same.

$C_3H_5O_3Na$, Sodium Lactate - Ether, (II 276) - Phenol, Schryver (1910).

$C_3H_5O_9N_3$, Trinitroglycerol, $C_3H_5(ONO_2)_3$ (II 173).

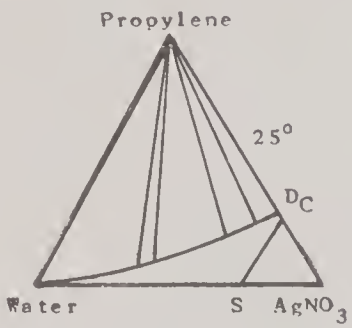
Solubility in aqueous solutions of Nitric Acid or Sodium Carbonate.

C_3H_6, Propylene, $CH_3CH{:}CH_2$. See acetic acid p. 886

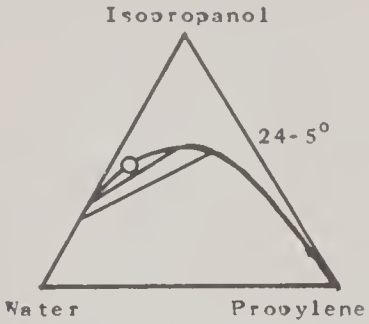
Propylene - $AgNO_3$, Silver Nitrate. (Francis, 1951).

Lower Layer[a]			Point
Water	C_3H_6	$AgNO_3$	
55.7	8.7	35.6	
46.9	10.9	42.2	
24.4	15.8	59.8	
11.2	21.4	67.4	
0.0	25.0	75.0	D
29	0	71.0	S^b
0	24.5	75.5	C^b

(a) Upper layer is pure propylene.
(b) Solution in equilibrium with silver nitrate crystals.



PROPYLENE - C_3H_8O, Isopropanol. Francis (1950).



Composition in gms. per 100 gms. Solution

Water	Isopropanol	Propylene	Water	Isopropanol	Propylene
-	-	-	6	40	54
75	25	0	12	51	37
65	32	3	18	54	28
41	46	13	Plait Point		

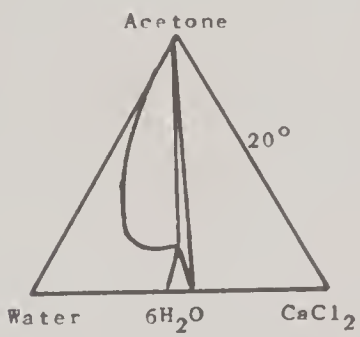
PROPYLENE - $C_{18}H_{33}O_2K$, Potassium Oleate.

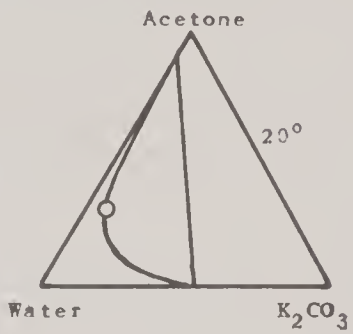
J. W. McBain and J. J. O'Conner, (J. Am. Chem. Soc. 63, 875 1941) indicated an increase in solubility of propylene at 400 mm. from 0.098 volumes in water to 0.39 volumes in 15% potassium oleate solution.

C_3H_6O, ACETONE, $(CH_3)_2CO$.

See CCl_4, CS_2, $CHCl_3$, C_2Cl_4, C_2HCl_3, C_2HCl_5, $C_2H_2Cl_4$, $C_2H_3Cl_3$.

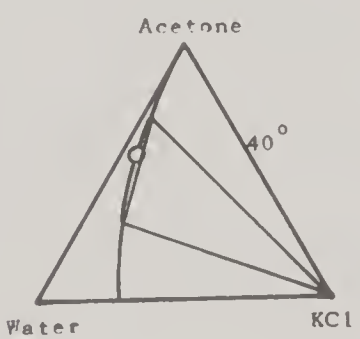
ACETONE - $CaCl_2$, Calcium Chloride (I 291).





ACETONE - K_2CO_3, Potassium Carbonate (I 738, II 175).

ACETONE - KCl, Potassium Chloride (I 780).



Correction: In the second table on p. I 780 "Lower Layer" and "Upper Layer" are interchanged. Instead of "48.50" % acetone read "38.50". The note is incorrect and should be omitted. The plait point is at about 43% water, 50.5% acetone, 6.5% KCl.

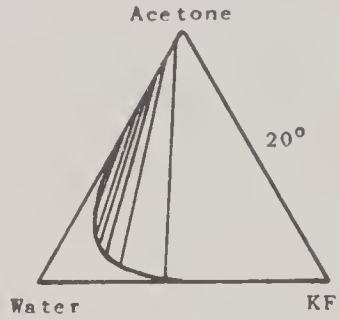
TERNARY AQUEOUS SYSTEMS

ACETONE - SALTS

ACETONE - KF, Potassium Fluoride (I 807).

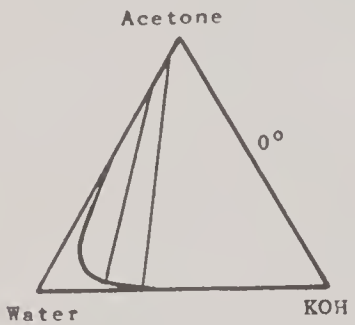
Frankforter and Cohen's observation of tie lines: Wt. % of KF in layers

Aqueous	Acetone
23.12	0.05
14.78	0.56
10.94	1.63
8.00	3.36



ACETONE - KOH, Potassium Hydroxide (I 852, 1286)

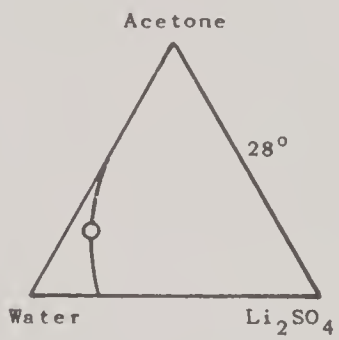
At the top of p. 1286 the data agree with the column headings, "KOH", and not with the title "Sodium Hydroxide". However, Gibby presented data for the latter also (see NaOH, below).



ACETONE - Li_2SO_4, Lithium Sulfate (Inter. Crit. Tables III 409)

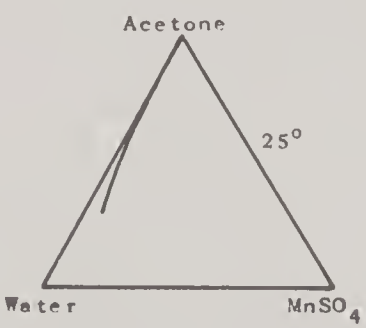
Data in gms. per 100 gms. Solution at 28° Read from the Curve

Water	Acetone	Li_2SO_4
43	56	1
50	47	3
60	34	6
65	26	9 P.P.
70	18	12
73	7	20



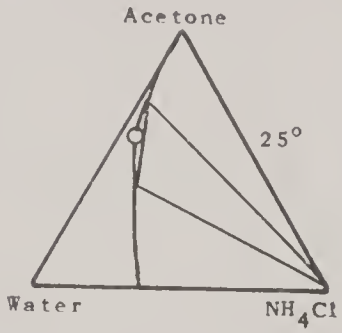
ACETONE - $MnSO_4$, Manganous Sulfate (II 175).

Correction: Instead of the column heading "$MgCO_3$" read "$MnSO_4$".



TERNARY AQUEOUS SYSTEMS

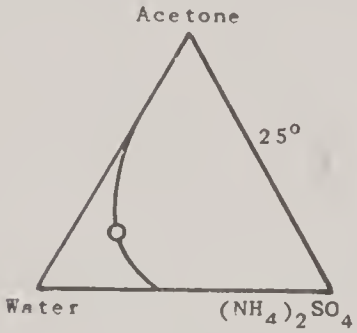
ACETONE - NH_4Cl, Ammonium Chloride (I 1091).



The plait point is at about 32% water, 62% acetone, 6% NH_4Cl. Additional data are given by Bogin (1924).

ACETONE - $(NH_4)_2SO_4$, Ammonium Sulfate (II 175).

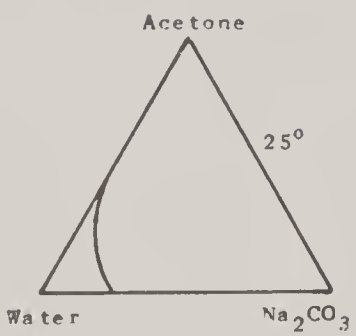
Instead of the column heading "$(NH_4)_2CO_3$" read $(NH_4)_2SO_4$.



Data Recalculated to gms. per 100 gms. Solution at 25°

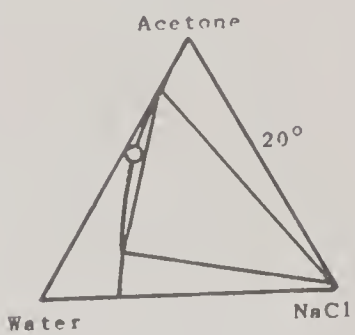
Water	Acetone	$(NH_4)_2SO_4$
23	77	0
50	48	2
60	35.5	4.5
67.5	20.5	12 P.P.
68	10	22
66	4	30
57	1	42

ACETONE - Na_2CO_3, Sodium Carbonate (II 175).



ACETONE - NaCl, Sodium Chloride (I 1241-2).

The plait point is at about 39% water, 56% acetone, 5% NaCl.



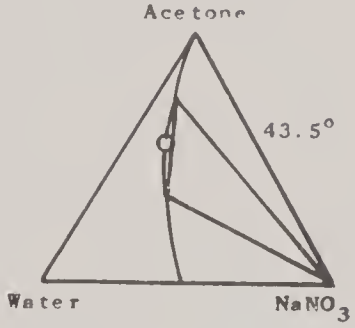
ACETONE - SALTS

ACETONE, $NaNO_3$, Sodium Nitrate.

No two liquid layers are formed at 30° or 40° (I 1281); but at 43.5° there are two liquid layers (Int. Crit. Tables III 410).

Compositions in gms. per 100 gms. Solution

Water	Acetone	$NaNO_3$
19	73	8
31	52.5	16.5 P.P.
36.5	35	28.5



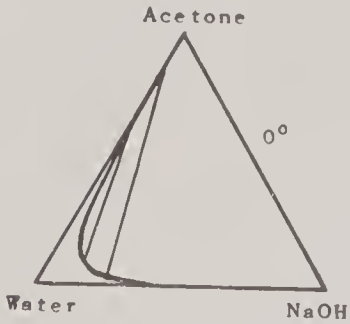
ACETONE - NaOH, Sodium Hydroxide.

C. W. Gibby, J. Chem. Soc., 1934, 9-10. The data on p.I 1286 are for KOH.

Compositions in gms. per 100 gms. Solution at 0°.

Water	Acetone	NaOH
26.4	73.3	0.3
41.5	57.4	1.1
60.9	34.8	4.3
67.4	26.7	5.9
73.7	18.3	8.0
78.2	9.6	12.2
75.5	4.9	19.6
71.7	1.1	27.2

Bogin (1924) also presented data for this system.



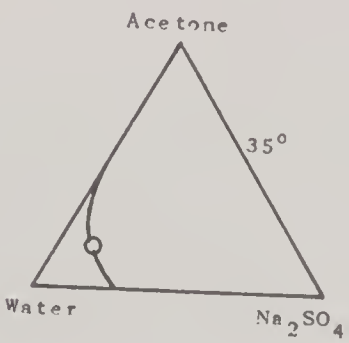
Tie lines: Wt. % NaOH in layers.

Aqueous	Acetone
12.74	0.5
21.1	0.06

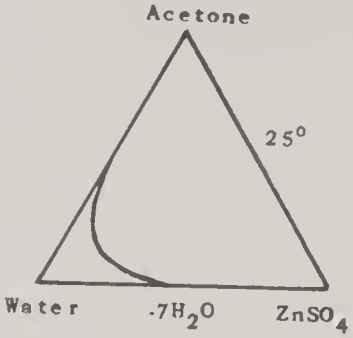
ACETONE - Na_2SO_4, Sodium Sulfate (Int. Crit. Tables III 410).

Compositions in gms. per 100 gms. Solution at 35°, Read from Curve.

Water	Acetone	Na_2SO_4
54	45	1
60	38	2
66	30	4
71	20	9
72	16	12 P.P.
72	10	18
70	1.5	28.5

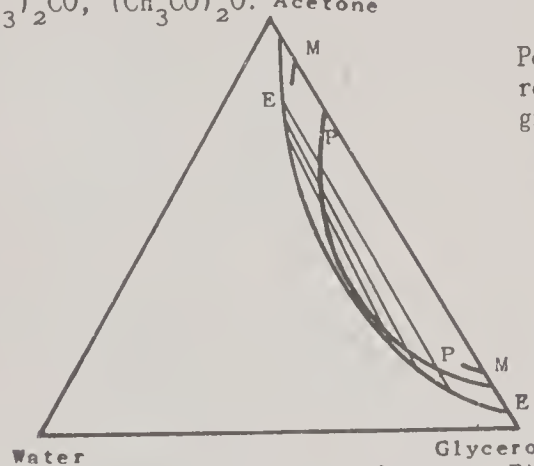


ACETONE - $ZnSO_4$, Zinc Sulfate (I 1596).



ACETONE - C_3H_8O, Glycerol, $C_3H_5(OH)_3$ (II 177).

Correction: In the table (bottom of p. II 177) the column headings should be rearranged to the order, $C_3H_5(OH)_3$, $(CH_3)_2CO$, H_2O, $C_3H_5(OH)_3$, $(CH_3)_2CO$, $(CH_3CO)_2O$.



Ponomorev's data (curve P) are recalculated to gms. per 100 gms. solution at 20°.

Water	Acetone	Glycerol
7.45	67.45	25.1
11.3	62.2	26.5
16.55	50.45	33.0
18.3	32.0	49.7
14.25	17.9	67.85
8.96	12.44	78.6
5.7	11.1	83.2

Elgin's data (1949) at 25° (curve E) are read from a graph.

Lower Layer			Upper Layer		
Water	Acetone	Glycerol	Water	Acetone	Glycerol
0	4	96	0	95	5
11	9	80	7	79	14
14	13	73	9	75	16
18	20	62	10	72	18
19	32	49	-	-	-
18	46	36	-	-	-

The discrepancies between Ponomarev's and Elgin's data are too great to be accounted for by the difference in temperature, and in fact are in the opposite direction. McEwen's data (II 180) on the binary system were interpolated and extrapolated to give 12 and 92% acetone respectively (points M on the graph). Some observations by the compiler on the ternary system are consistent with McEwen's, but give a maximum of only 16% water for the curve. The plait point was located at 13.5% water, 55% acetone, 31.5% glycerol. The discrepancies may be due to the extremely slow settling in this system.

ACETONE - $C_4H_6O_2$, Vinyl Acetate, $CH_2:CHOCOCH_3$

J. C. Smith, J. Phys. Chem. 46, 279 (1942).

Compositions in gms. per 100 gms.
Solution at 25°

Tie lines:

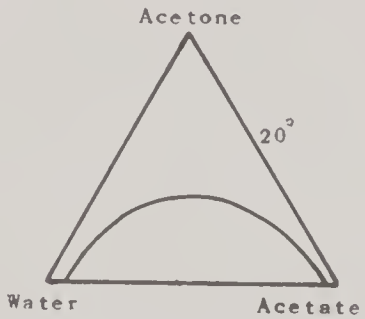
Water	Acetone	Vinyl Acetate	Acetone in layers: Aqueous	Organic
0.1	0.0	99.9	2.2	8.0
2.0	15.0	83.0	6.2	14.0
4.0	32.5	63.5	9.7	18.4
10.8	51.0	38.2	15.0	27.2
19.6	53.3	27.1	19.3	34.2
31.2	50.2	18.6	24.3	42.8
45.8	43.6	10.6	30.0	47
59.5	34.4	6.1	35.2	50.6
73.1	22.8	4.1	39.2	52.9
97.5	0.0	2.5	44.1	53.3

Additional data are presented by H. R. C. Pratt and S. T. Glover, Trans. Inst. Chem. Engrs. (London), 24 54 (1946).

ACETONE - $C_4H_8O_2$, Ethyl Acetate. (Int. Crit. Tables III 414).

Data in gms. per 100 gms.
Solution at 29°

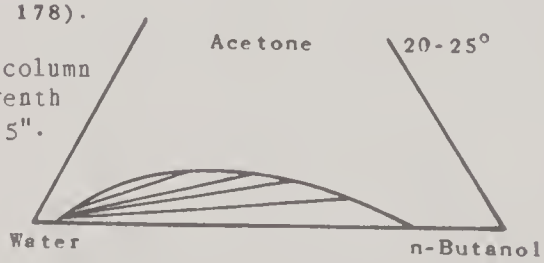
Water	Acetone	Acetate
91.47	0	8.53*
70	20	10
50	31	19
30	36	34
16	34	50
7	23	70
5	15	80
3.52*	0	96.48



*Data from binary system (II 244).
No tie lines are given.

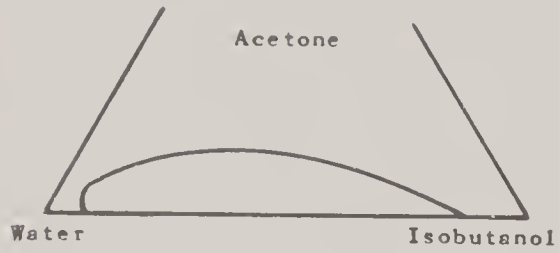
ACETONE - $C_4H_{10}O$, n-Butanol (II 177, 178).

Corrections: On p. II 178, third column Instead of "1.69" read "11.69." Seventh column, instead of "12.5" read "12.15".



ACETONE

ACETONE - $C_4H_{10}O$, Isobutanol. (Fritzsche and Stockton, 1946).

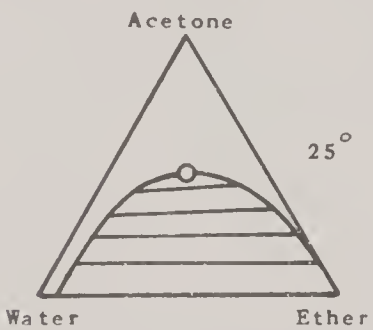


Compositions in gms. per 100 gms. Solution at 25°

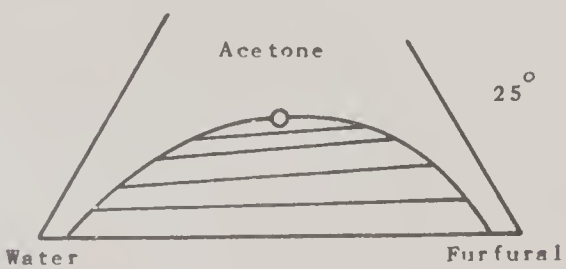
Water	Acetone	Isobutanol
92	0	8[a]
88	6	6
78.3	10.3	11.4
68.6	13.4	18.0
54.9	15.4	29.7
42.4	15.9	41.7
26.3	11.6	62.1
20.5	6.0	73.5
16.8	0	83.2[a]

(a) Data interpolated from binary system (II 268).

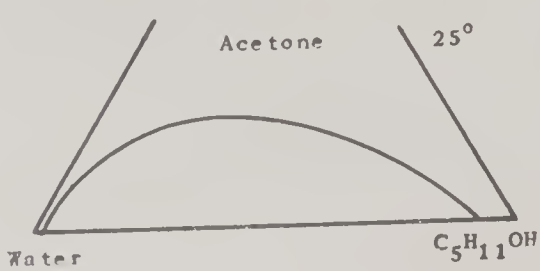
ACETONE - $C_4H_{10}O$, Ether. Vlček (1935); Mondain-Monval and Quiquarez (1944). The data are fragmentary. The plait point and peak of the curve are at about 29% water, 47% acetone, 24% ether. The tie lines are nearly horizontal.



ACETONE - $C_4H_5O_2$ - FURFURAL, $CH{:}CH\rangle O$ / $CH{:}C\langle CHO$ (II 179)



ACETONE - $C_5H_{12}O$, n-Amyl Alcohol (Int. Crit. Tables III 414).



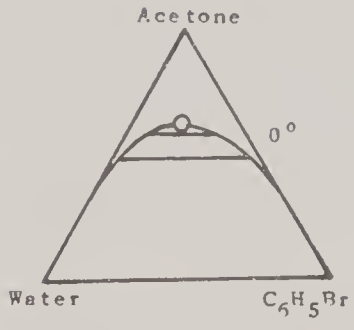
Data in gms. per 100 gms. Solution

Water	Acetone	$C_5H_{11}OH$
80	17	3
66	24	10
55.5	26.5	18

ACETONE - C_6H_5Br, Bromobenzene (II 176).

Bonner's data at 0° Recalculated to gms. per 100 gms. Solution

Water	Acetone	C_6H_5Br
53.0	45.9	1.1
39.2	56.5	4.3
27.4	60.8	11.8
19.7	61.4	18.9
11.9	60.3	27.8
4.7	53.1	42.2
1.4	40.7	57.9

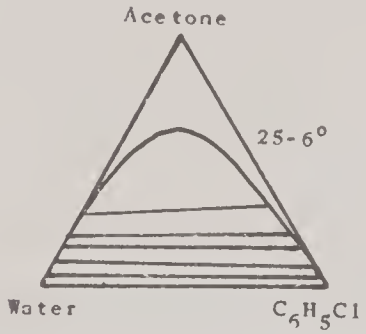


Tie lines: Wt. % Acetone in layers

Aqueous	C_6H_5Br
51	53
60	60

The system is unusual in being almost perfectly symmetrical. The plait point is at the apex of the curve and the tie lines given are nearly horizontal. The system is probably solutropic with one and perhaps two or three exactly horizontal tie lines.

ACETONE - C_6H_5Cl, Chlorobenzene



Othmer, White and Trueger (1941). Compositions in gms. per 100 gms. Solution. (See note under $C_2H_2Cl_4$). p.879

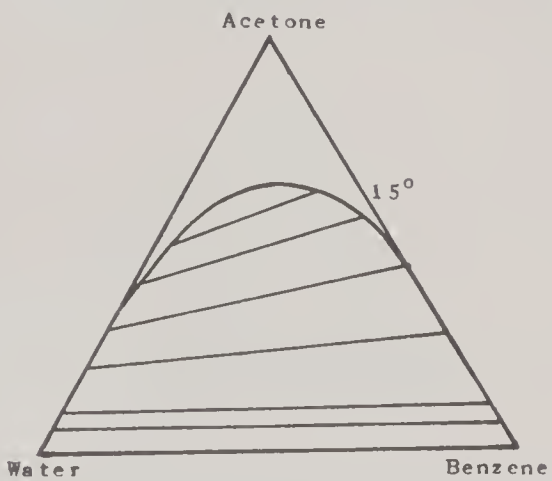
Upper Layer			Lower Layer		
Water	Acetone	C_6H_5Cl	Water	Acetone	C_6H_5Cl
97.33	2.5	0.15	0.24	2.5	97.3
92.8	6.99	0.19	0.36	6.85	92.8
86.3	13.47	0.26	0.5	13.75	85.75
80.7	19.0	0.31	0.75	20.9	78.35
72.9	26.5	0.45	1.6	31.9	66.5
54.8	43.3	1.88	-	-	-
47.2	49.3	3.45	-	-	-
-	-	-	14.0	62.0	33.9
-	-	-	17.8	62.1	20.5
-	-	-	22.76	61.3	15.86
36.88	56.0	7.17	-	-	-
29.68	59.7	11.28	-	-	-

The system is solutropic with at least one horizontal tie line (at about 9% acetone).

ACETONE - C_6H_6, Benzene (II 179, 182, 183).

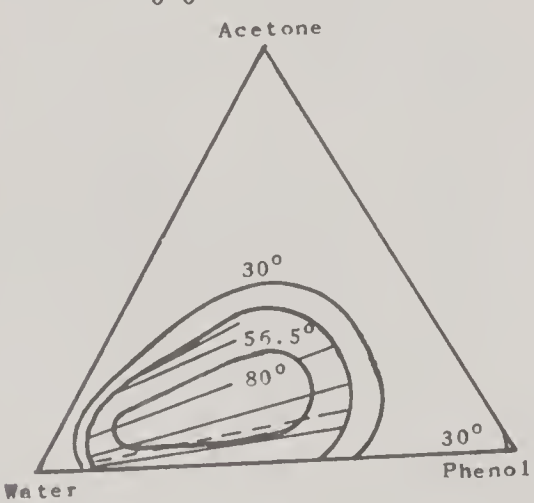
Correction: In the distribution reported by Philip and Bramley (II 182) read 0.17 instead of 0.12. (S. W. Briggs and E. W. Comings, Ind. Chem. 35, 41 (1943).

t°	Lower Layer			Upper Layer		
	Water	Acetone	Benzene	Water	Acetone	Benzene
15	94.9	5	0.1	0.1	4.7	95.2
	89.9	10	0.1	0.2	10.8	89.0
	79.7	20	0.3	0.5	26.1	73.4
	69.3	30	0.7	1.8	43.0	55.2
	58.6	40	1.4	4.4	56.5	39.1
	46.2	50	3.2	8.5	63.9	27.6
30	94.9	5	0.1	0.2	5.8	94.0
	79.6	20	0.4	0.9	30.4	68.7
	58.2	40	1.8	6.6	58.9	34.5
	45.9	50	4.1	12.0	64.1	23.9
45	94.8	5	0.2	0.2	6.9	92.9
	79.5	20	0.5	1.8	34.6	63.6
	57.7	40	2.3	9.7	60.6	29.7



Many additional observations on compositions on the binodal curve are presented. The system seems to be solutropic at 15° but not at 30° and 45°. Additional data on this system are given by Jacobs (1914), Bogin (1924), Ormandy, Pond and Davies (1934, Vlček (1935), Sata and Kimura (1935).

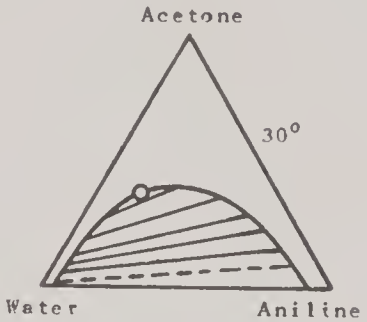
ACETONE - C_6H_6O, Phenol (II 378). Correction: In the table at 30° instead of "81.1%" $(CH_3)_2CO$ read "18.1%". The system is one of a few with an "island" curve and a ternary critical point (at 92°).



Tie lines in gms. per 100 gms. at 56.5°.

Aqueous Layer			Phenolic Layer		
Water	Acetone	Phenol	Water	Acetone	Phenol
85.5	0	14.5	40.0	0	60.0
88.8	1.2	10.0	29.3	7.3	63.4
89.1	3.9	7.0	23.5	17.1	59.4
86.7	7.3	6.0	22.5	28.0	49.5
76.0	16.9	7.1	28.6	36.1	35.3
69.5	21.5	9.0	34.0	37.5	28.5

The system probably has an isopycnic at each temperature with two liquid phases of equal density. The dashed line shows the estimated position. The short line near the phenol corner shows equilibrium at 30° with solid phenol.



ACETONE - C_6H_7N, Aniline, $C_6H_5NH_2$ (II 183).

Correction: In the fifth column of the table instead of "5.5" read "15.5". According to Mondain-Monval and Quiquarez (1940) the system has an isopycnic whose estimated position is shown by the dashed line connecting compositions of phases of equal density.

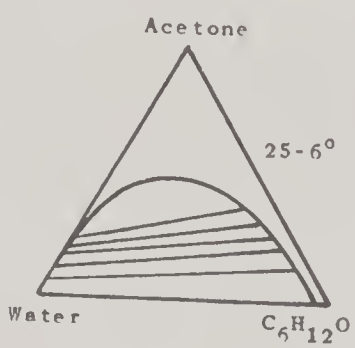
ACETONE - C_6H_9ON, Vinylpyrrolidone, see that formula.

ACETONE - C_6H_{12}, Cyclohexane. Some fragmentary data are given by Ormandy, Pond, and Davies (1934).

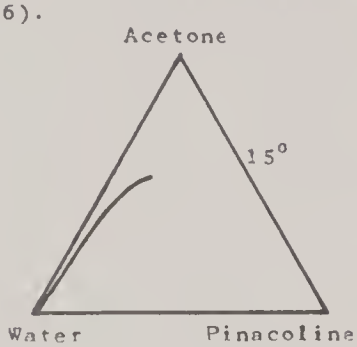
ACETONE - $C_6H_{12}O$, Methyl Isobutyl Ketone, $CH_3COCH_2CH(CH_3)_2$

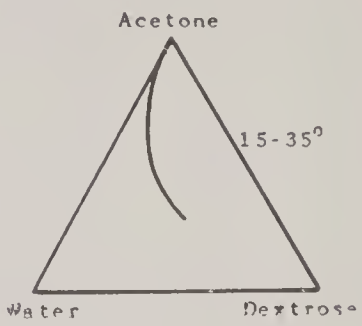
Othmer, White, and Trueger (1941) (see note under $C_2H_2Cl_4$). p.879

Lower Layer			Upper Layer		
Water	Acetone	$C_6H_{12}O$	Water	Acetone	$C_6H_{12}O$
98.0	0	2.0	2.3	0	97.7
92.2	5.58	2.2	3.0	10.66	86.3
85.7	11.83	2.5	3.8	18.0	78.2
81.75	15.35	2.9	4.9	25.5	69.6
76.2	20.6	3.2	6.0	30.5	63.5
72.4	23.8	3.8	7.3	35.3	57.4
64.2	30.9	5.01	-	-	-
-	-	-	10.7	43.2	46.2
-	-	-	18.8	48.3	32.8
-	-	-	23.4	50.7	25.9
-	-	-	32.8	46.6	20.5
45.0	42.7	12.4	-	-	-



ACETONE, $C_6H_{12}O$, Pinacoline, or Methyl tert Butyl Ketone $CH_3COC(CH_3)_3$ (II 436).

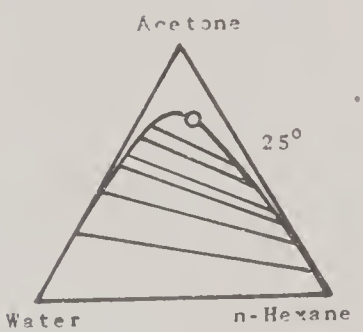




ACETONE - $C_6H_{12}O$, Dextrose (II 176).

ACETONE - C_6H_{14}: n-Hexane. Treybal and Vondrak (1949).

Lower Layer			Upper Layer		
Water	Acetone	Hexane	Water	Acetone	Hexane
72.8	27.01	0.19	0.0	9.28	90.72
56.1	43.55	0.35	0.3	21.10	78.6
46.5	52.61	0.89	0.4	29.28	70.32
41.0	57.64	1.36	0.8	36.21	62.99
35.0	63.00	2.0	1.2	44.20	54.6
28.5	68.52	2.98	1.8	52.16	46.04
15.9	74.01	10.09	Apex Plait Point		
11.8	71.1	17.1			

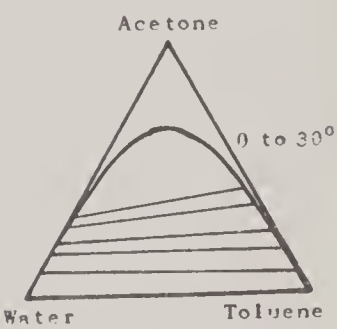


ACETONE - C_7H_8, Toluene (II 180, 182).

Othmer, White, and Trueger (1941).

Tie lines: Wt. % Acetone in layers:

Aqueous	Toluene
9.75	8.14
17.07	17.33
21.3	25.3
29.2	34.0
32.5	41.3

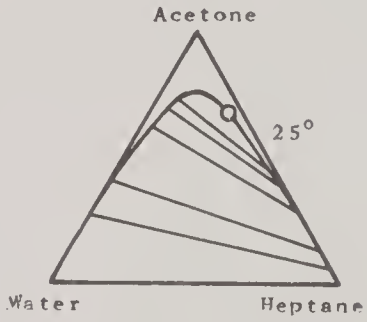


The system is solutropic having a horizontal tie line at about 16% acetone. Additional data are given by Leikola (1940).

ACETONE - C_7H_{16}, n-Heptane. Treybal and Vondrak (1949).

Lower Layer			Upper Layer		
Water	Acetone	Heptane	Water	Acetone	Heptane
75.2	24.79	0.01	0.0	6.80	93.2
59.7	40.00	0.3	0.0	12.41	87.59
36.0	62.97	1.03	0.6	27.22	72.18
23.6	73.11	3.29	1.0	38.02	60.98
20.2	75.03	4.77	1.0	41.00	58.00
14.21	76.17	9.62	-	-	-
5.0	67.5	27.5	Plait Point		

Additional data are given by Ormandy, Pond, and Davies(1934).



ACETONE - Gasoline. Fragmentary data are given by Ormandy, Pond, and Davies(1934).

ACETONE - C_8H_{10}, o-Xylene, $C_6H_4(CH_3)_2$. Sheibel and Karr (1950). Distribution data in gms. acetone per 100 gms. of the layers.

Aqueous	Acetone	Aqueous	Acetone
0.911	0.596	7.96	6.19
1.80	1.185	9.0	6.85
3.57	2.31	15.9	13.67
5.19	3.68	22.0	20.05

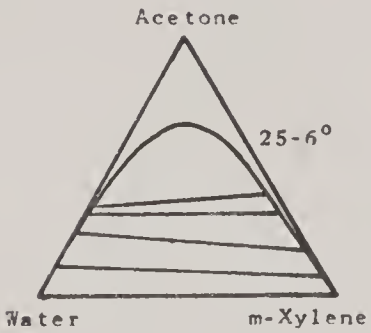
ACETONE - C_8H_{10}, Xylene. Othmer, White, and Trueger (1941).

The xylene is presumably largely the meta isomer. See note under $C_2H_2Cl_4$, p. 879

Compositions in gms. per 100 gms. solution.

ACETONE

Lower Layer			Upper Layer		
Water	Acetone	Xylene	Water	Acetone	Xylene
90.6	9.33	0.1	0.1	6.15	93.8
77.5	22.3	0.2	0.15	16.9	82.95
67.5	32.1	0.4	0.5	31.8	67.7
65.25	34.3	0.45	1.07	39.9	59.0
55.6	43.7	0.83	-	-	-
-	-	-	2.5	51.9	45.6
-	-	-	5.1	61.1	33.9
34.3	60.5	5.32	-	-	-
-	-	-	10.9	66.6	22.6
22.00	65.0	13.0	-	-	-



The system is solutropic with a horizontal tie line at about 32% acetone. The o-xylene system above probably would show the same condition if distribution data had extended to higher concentrations of acetone.

Additional data are given by Leikola (1940) and the system is discussed by Sata and Kimura (1935).

ACETONE - $C_8H_{18}O$, n-Butyl Ether. Othmer, White, and Trueger (1941).

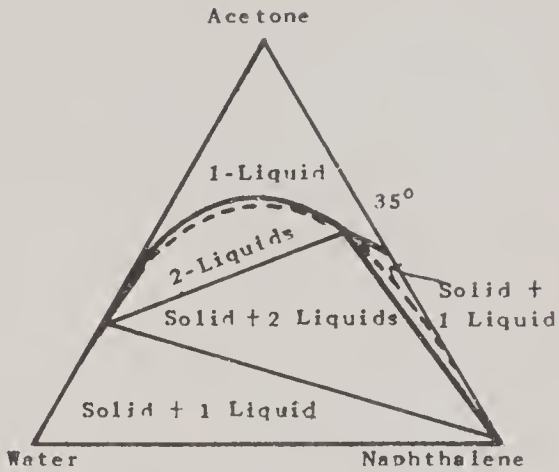
Distribution data at 25-6° in gms. acetone per 100 gms. of layers.

Aqueous	Butyl Ether
2.0[a]	1.03[a]
10.6	4.92
19.8	9.79
28.0	16.9
38.4	26.3

(a) These two values are interchanged in the original, apparently a typographical error.

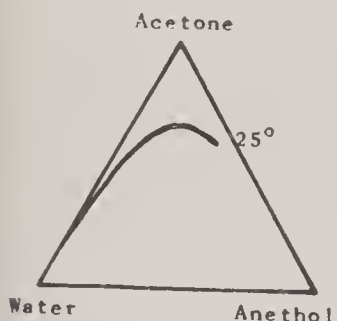
ACETONE - $C_{10}H_8$, Naphthalene (II 175, 649, 650).

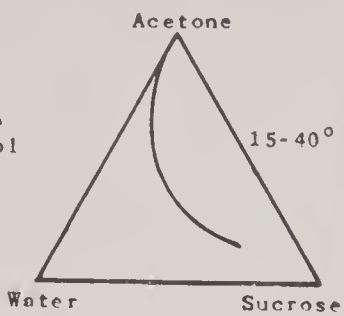
The graph is based only partly on data in the literature and required additional experiments. The dashed curves are unstable equilibria (position postulated). That along the right side is part of the binodal curve if crystallization of naphthalene could be prevented. The dashed arc near the top is the equilibrium of crystals with one liquid if separation into two liquids could be prevented.

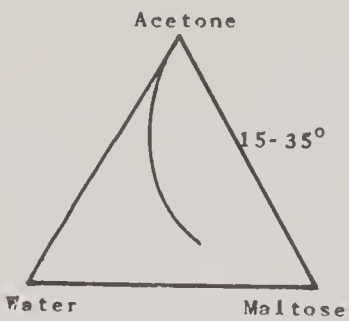


ACETONE - $C_{10}H_{12}O$, Anethol or p-Propenylanisole, $CH_3CH{:}CHC_6H_4OCH_3$ (II 175).

ACETONE - Sucrose or Maltose, $C_{12}H_{22}O_{11}$ (II 176).





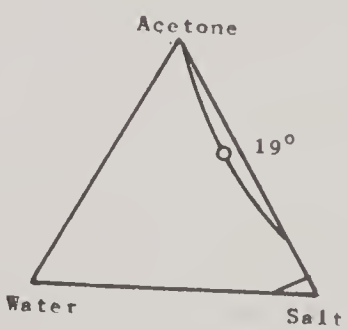


ACETONE - $C_{20}H_{24}O_2N_2(BiI_3)_2 \cdot 2HI$, Quinine Iodobismuthate (I 202, II 808).

The position of the solid line at the lower corner is conjectural.

ACETONE - $C_{57}H_{104}O_6$, Triolein or Olive Oil (II 181).

Distribution coefficient.

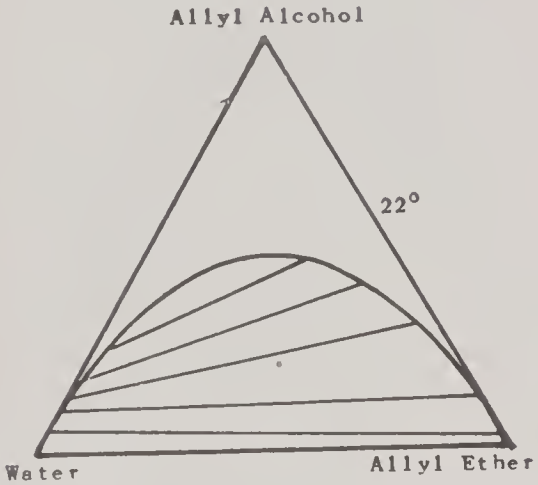


ACETONE

C_3H_6O, Allyl Alcohol, $CH_2:CHCH_2OH$. See CCl_4, C_2HCl_3.

ALLYL ALCOHOL - $C_6H_{10}O$, Allyl Ether $(CH_2:CHCH_2)_2O$.

A. W. Fairburn, H. A. Cheney, and A. J. Cherniavsky, Chem. Eng. Progress, 43, 280 (1947). The graph is presented but with no numerical data. The apex is at about 48% allyl alcohol. The system is solutropic with a horizontal tie line at about 12% allyl alcohol.



ALLYL ALCOHOL - Salts

Data are presented from which binodal curves could be constructed for salting out allyl alcohol, similar to those for methanol, ethanol, and acetone. In the following are given the reference in Seidell Vol. I and the apex of the curve or maximum percentage of water for two liquid layers:

Salt	Reference	% Water
K_2CO_3	I 739	73.6
KF	I 806	75.4
Na_2CO_3	I 1245	> 74.1
NaCl	I 1245-6	> 67.7 (estd. 73)

KCl and NaF failed to give two liquid phases at 20° (Frankforter and Temple, 1915).

$C_3H_6O_2$, Methyl Acetate. MgI, Magnesium Iodide (I 974). Two layers are formed at high temperatures.

METHYL ACETATE - Ethanol. Equal volumes are miscible with water (Pfeiffer 1892).

$C_3H_6O_2$, Ethyl Formate - Ethanol. Equal volumes are miscible with water (Pfeiffer 1892).

ETHYL FORMATE - Olive Oil (Int. Crit. Tables III 425).

Distribution.

PROPIONIC ACID

$C_3H_6O_2$, Propionic Acid, CH_3CH_2COOH. See CCl_4, CS_2, $CHCl_3$.

The distribution of propionic acid between water and several organic solvents are given in Seidell Vol. II. Many of these distributions probably extend to the apex of the curve, so that an approximate graph could be drawn, assuming the curve is symmetrical. They are listed as follows, the "propionic acid" being the calculated maximum concentration listed in gms. per 100 gms. solution, which may be close to the apex.

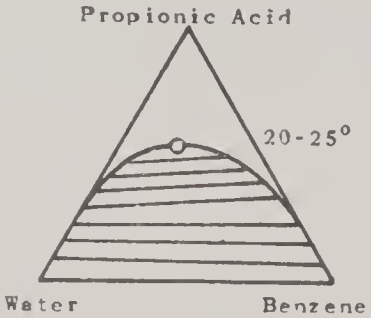
Formula	Solvent	Page	Propionic Acid
C_2H_5Br	Ethyl Bromide	188	25.5
C_4H_8O	2-Butanone[a]	189	-
$C_4H_{10}O$	Ether	188	49
$C_4H_{10}O$	n-Butanol[a]	189	-
$C_4H_{10}O$	Isobutanol	188	32
$C_4H_{10}O$	sec-Butanol[a]	189	-
	Petroleum Ether[a]	193	-
$C_5H_{12}O$	n-Amyl Alcohol[a]	189	-
$C_5H_{12}O$	tert-Amyl Alcohol[a]	189	-
$C_5H_{12}O$	Isoamyl Alcohol	189	42
$C_6H_5O_2N$	Nitrobenzene	190	47
C_6H_6	Benzene[b]	189-90	55.5
C_6H_7N	Aniline[b]	191-2	27.11
$C_6H_{12}O$	Methyl Isobutyl Ketone[a, b]	-	-
$C_7H_7O_2N$	o-Nitrotoluene	190	63
C_7H_8	Toluene[b]	190	59.0
C_7H_9N	o-Toluidine[b]	192,558	34.7
C_7H_9N	m-Toluidine[b]	-	32.23
C_8H_{10}	Xylene[b]	191	62.9
$C_{10}H_{18}$	Decalin[b]	191	69
$C_{57}H_{104}O_6$	Olive Oil[a]	193	-
	Cottonseed Oil	187	67.3

(a) Only low concentrations.

(b) Listed below.

PROPIONIC ACID

PROPIONIC ACID - C_6H_6, Benzene (II 189-90).

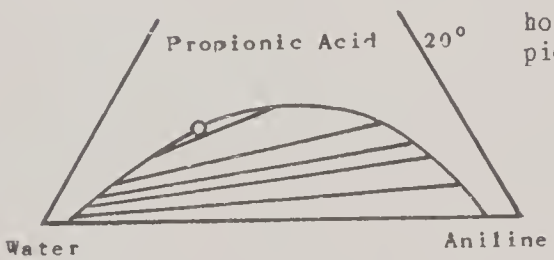


Leikola's data (1940) at 20-21° recalculated to gms. per 100 gms. solution.

Water	Acid	Benzene
52.2	43.5	4.3
27.8	55.5	16.7
10.0	53.0	37.0
1.5	32.8	65.7

The system is solutropic. It may even be a double solutrope with two horizontal tie lines. Some of the tie lines shown are only approximate since they were actually observed at 0° and 60°.

PROPIONIC ACID - C_6H_7N, Aniline (II 191-2).



The system is solutropic with a horizontal tie line at about 1% propionic acid.

PROPIONIC ACID - $C_6H_{12}O$, Methyl Isobutyl Ketone, $CH_3COCH_2CH(CH_3)_2$.

(H. F. Johnson and H. Bliss, Trans. Am. Inst. Chem. Engrs. 42, 337, 1946).

Distribution in gms. per 100 gms. in the layers.

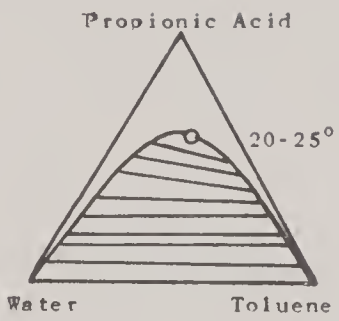
t°	Aqueous	Ketone	t°	Aqueous	Ketone
26.7	1.25	3.04	29.4	1.22	2.93
	2.36	6.08		2.36	5.93
	3.37	8.95		3.42	8.87

PROPIONIC ACID - $C_6H_{14}O$, Isopropyl Ether (II 112, ref.).

PROPIONIC ACID - C_7H_8, Toluene (II 190).

Leikola's data (1940) at 20-21° recalculated to gms. per 100 gms. solution.

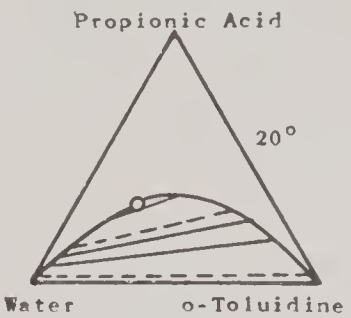
Water	Propionic Acid	Toluene
38.5	55.9	5.6
23.3	59.0	17.7
8.1	54.1	37.8
1.15	33.0	65.85



The tie lines are listed (p. II 190). The last one shows identical concentrations of acid in each layer, about equal to that of the peak of the curve from Leikola's data, with reasonable estimates of the unreported densities. It is concluded that the plait point is near that point.

PROPIONIC ACID - C_7H_9N, o-Toluidine (II 192, 555, 558).

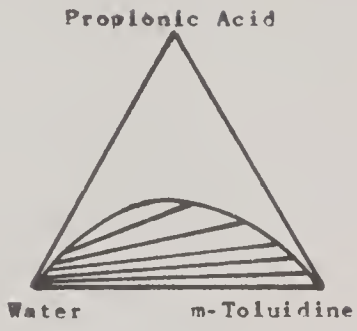
This system has two isopycnics (dashed lines) or tie lines connecting compositions of equal density. It is the only such ternary system published so far as the compiler knows. The phenomenon is due to the closeness in density of all three components. Below 24.5° o-toluidine is slightly heavier than water; but a little propionic acid increases the density of water more than that of toluidine, making it the heavier layer. Larger amounts of propionic acid eventually increase the density of the toluidine layer enough to make it sink again.



PROPIONIC ACID - C_7H_9N, m-Toluidine. (Angelescu and Cristodulo, 1941-2).

Gms. per 100 gms. solution at 0°			Gms. per 100 gms. solution at 20°		
Water	Propionic Acid	m-Toluidine	Water	Propionic Acid	m-Toluidine
98.70	-	1.30	98.80	-	1.20
92.60	3.22	4.18	91.02	4.78	4.20
84.8	8.45	6.75	80.16	12.73	7.11
70.89	17.78	11.33	67.21	20.15	12.64
58.02	24.44	17.54	56.48	24.69	18.83
44.25	30.53	25.22	43.21	28.02	28.77
30.90	34.70	34.40	34.04	31.36	34.60
21.58	32.73	45.69	26.63	32.23	41.14
14.65	26.96	58.39	19.36	30.42	50.22
6.27	13.35	80.38	11.89	22.87	65.24
4.03	6.07	89.90	7.69	15.63	76.68
2.76	-	97.24	3.85	5.02	91.13
			2.77	-	97.23

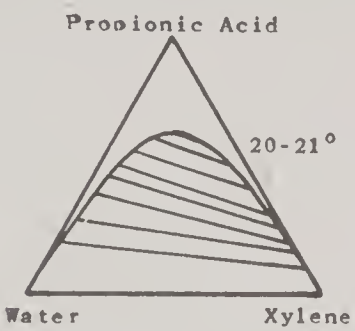
PROPIONIC ACID



Distribution at 20°. Gms. propionic acid in 100 gms. layers

Aqueous	m-Toluidine
0.82	1.11
2.69	4.94
4.98	10.91
7.23	18.15
9.58	24.49
13.59	30.97

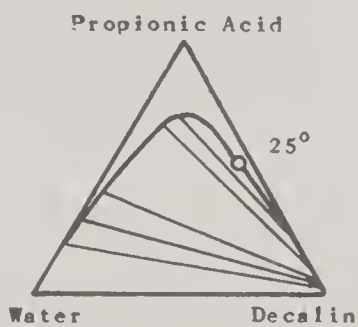
PROPIONIC ACID - C_8H_{10}. Xylene (II 191).



Leikola's data (1940) at 20-21° recalculated to gms. per 100 gms. solution

Water	Propionic Acid	Xylene
33.0	60.9	6.1
18.2	62.9	18.9
7.1	54.7	38.2
1.0	33.0	66.0

PROPIONIC ACID - $C_{10}H_{18}$. Decalin (Decahydronaphthalene). (II 191).

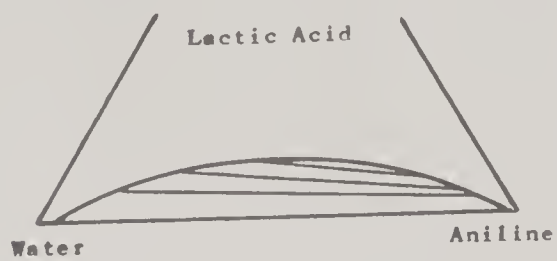


Although only distribution is given, the final slight drop in concentration in the aqueous layer indicates passing of the peak of the curve, so that a complete ternary diagram can be drawn approximately.

$C_3H_6O_3$ - Lactic Acid, Hydroxypropionic Acid, $CH_3CHOHCOOH$.

Distribution constants with 51 substances. See Acetic Acid p. 900 Other distributions are with chloroform (II 194), ether (II 194), isoamyl alcohol (II 195) isopropyl ether (II 112, ref.) o-toluidine (II 195), and n-amyl alcohol (II 195).

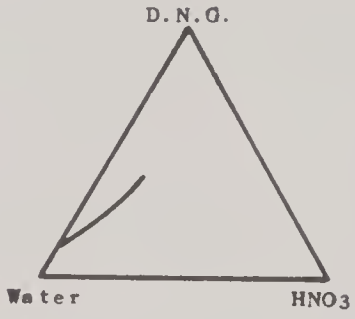
LACTIC ACID - Aniline (II 414).



Data for the curve are given for 0° also.

$C_3H_6O_7N_2$, Dinitroglycerol, $(CH_2ONO_2)_2 \cdot CHOH$. ('D.N.G.').

Solubility in aqueous solutions of nitric acid and sodium carbonate (II 173). Temperature not stated.



C_3H_7N, Allyl Amine, $CH_2:CHCH_2NH_2$.

ALLYL AMINE - C_8H_{10} Xylene (II 198).

Distribution.

$C_3H_7O_2N$, Alanine or α Amino-propionic acid. Distribution between water and butanol (II 200).

$C_3H_7O_2N$, Urethane, Ethyl carbamate, $NH_2COOC_2H_5$.

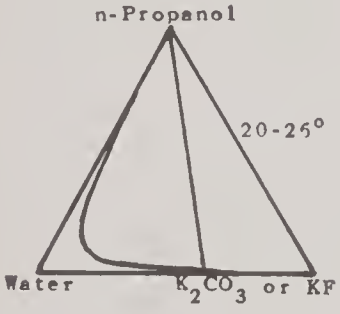
Distribution between water and olive oil (II 203).

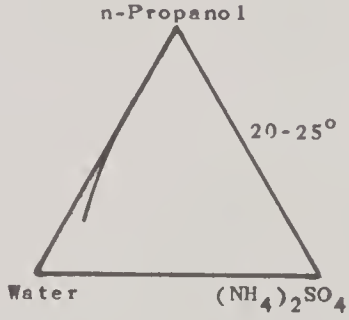
C_3H_8O, n-Propanol. See CCl_4, CS_2, $CHCl_3$, CH_3I, CH_3NO_2, C_2H_5Br, $C_4H_8O_2$ (Ethyl acetate), $C_4H_{10}O$, (n-Butanol), C_5H_{10}, C_6H_{12} (Cyclohexane).

n-Propanol - $AgNO_3$, $BaCl_2$, $CaCl_2$, KCl, KNO_3, Na_2SO_4. Fragmentary data are given by Timmermans (1907).

n-PROPANOL - K_2CO_3, Potassium carbonate (I 738).

n-PROPANOL - KF, Potassium Fluoride (I 806).





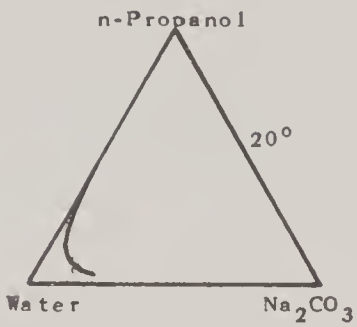
n-PROPANOL - $MgSO_4$ (1994); NH_4NO_3 (I 1113); $(NH_4)_2HPO_4$ (I 1119) (references only).

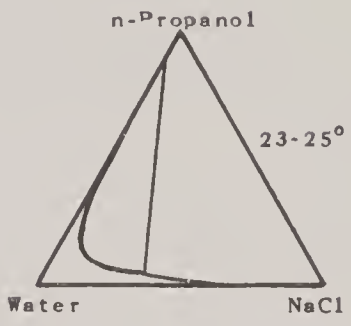
n- PROPANOL - $MnSO_4$, Na_2SO_4 (Linebarger, Am. Chem. J. 14, 380 (1892).

n-PROPANOL - $(NH_4)_2SO_4$ (I 1131).

n-PROPANOL - Na_2CO_3. Sodium Carbonate (I 1212).

n-PROPANOL - NaCl, Sodium Chloride (I 1242).

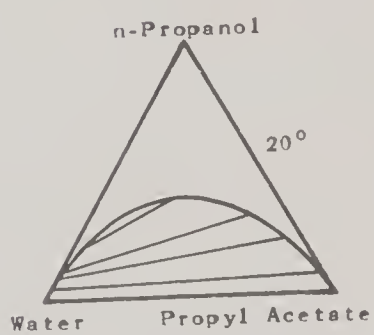


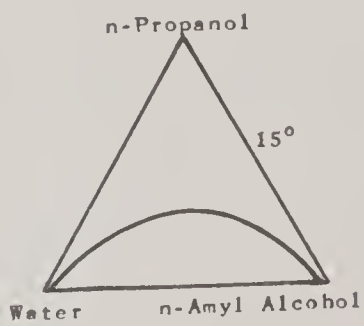


n-PROPANOL - $C_5H_{10}O_2$, n-Propyl Acetate. (T. E. Smith and R. F. Bonner, Ind. Eng. Chem., 42, 896 1950).

Compositions in gms. per 100 gms. solution.

Lower Layer				Upper Layer		
Water	Propanol	Acetate	t°	Water	Propanol	Acetate
97.8	0.0	2.2	20	1.7	0.0	98.3
92.1	5.5	2.4		3.8	9.1	87.1
88.4	9.3	2.3		8.9	23.4	67.7
85.4	12.1	2.5		15.4	33.5	51.1
77.7	18.5	3.8		33.0	41.4	25.6
98.2	0.0	1.8	35	2.2	0.0	97.8
94.3	3.7	2.0		3.7	7.9	88.4
91.9	6.1	2.0		6.8	16.7	76.5
89.5	8.3	2.2		10.7	26.3	63.0
87.1	10.7	2.2		16.2	34.3	49.5
84.2	13.2	2.6		23.1	39.9	37.0
79.6	16.9	3.5		32.6	42.1	25.3





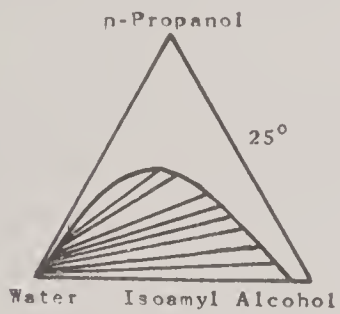
n-PROPANOL - $C_5H_{12}O$, n-Amyl Alcohol

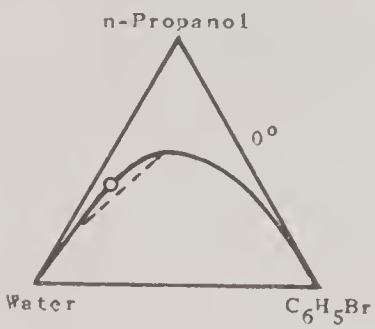
One point on the binodal curve, 26.1% water, 30% n-propanol, 43.9% n-amyl alcohol is calculated from the data of Holmes (1918) at 15°. The extremities of the curve, 2.5% and 92.5% n-amyl alcohol, are extrapolated from the data on p. II 316.

n-PROPANOL - $C_5H_{12}O$, Isoamyl Alcohol, $(CH_3)_2CHCH_2CH_2OH$. (II 207).

The tie lines of Coull and Hope are recalculated to gms. per 100 gms. of the layers:

Aqueous Layer			Isoamyl Alcohol Layer		
Water	Propanol	$C_5H_{12}O$	Water	Propanol	$C_5H_{12}O$
94.7	3.2	2.1	11.5	8.45	80.05
93.6	4.1	2.3	12.9	14.7	72.4
91.3	6.4	2.3	14.4	21.4	64.2
89.3	8.2	2.5	16.7	27.0	56.3
87.7	10.2	2.1	18.0	31.6	50.4
85.6	12.1	2.3	27.0	37.7	40.3
79.9	17.5	2.6	27.8	42.4	29.8
78.6	18.8	2.6	32.6	43.7	23.7





n-PROPANOL - C_6H_5Br, Bromobenzene (II 206).

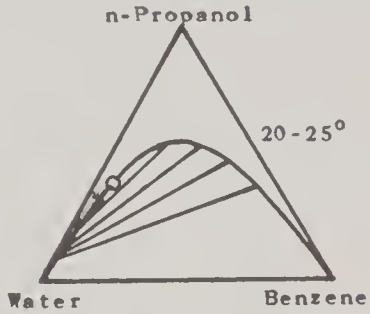
Bonner's data at 0° recalculated to gms. per 100 gms. solution.

Water	n-Propanol	C_6H_5Br
67.2	31.4	1.4
52.6	41.5	5.9
50.0	42.5	7.5 P.P.
41.5	48.1	10.4
33.5	52.1	14.4
22.8	54.4	22.8
14.6	52.2	34.2
10.7	46.5	42.8
6.3	36.7	57.0
1.4	15.7	82.9

The tie lines reported by Bonner for this system would cross. This is impossible and is probably due to typographical errors (in the original). The system is solutropic, with a horizontal tie line at about 5% propanol. It also has an isopycnic, dashed line, connecting compositions of liquid layers of equal density.

n-PROPANOL - C_6H_6, Benzene.

Leikola's data (1940) at 20-21° are recalculated to gms. per 100 gms. solution.



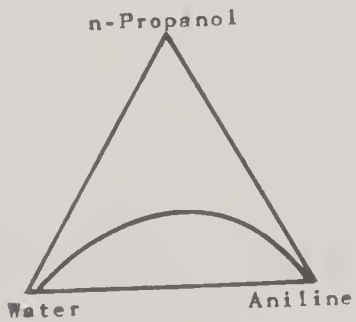
Water	Propanol	Benzene
57.1	39.0	3.9
35.2	54.0	10.8
24.8	57.9	17.3
16.7	55.5	27.8
12.4	51.5	36.1
8.7	45.6	45.7
5.7	38.7	56.6
4.2	31.9	63.9

Data for tie lines at 25° are given by C. G. Denzler, J. Phys. Chem., 49, 358 (1945) in the same units:

Lower Layer			Upper Layer		
Water	Propanol	Benzene	Water	Propanol	Benzene
83.3	16.3	0.4	5.4	39.8	54.8
82.1	17.2	0.7	6.5	46.3	47.2
81.1	18.1	0.8	9.1	50.1	40.8
79.8	19.2	1.0	14.8	57.3	27.9
73.0	25.3	1.7	23.6	57.8	18.6
56.0	39.8	4.2		Plait Point	

One point on the curve, 12.8% water, 42.8% n-propanol, 44.4% benzene is calculated from the data of Holmes (1918) at 15°. It is inconsistent with the data of Leikola and Denzler, above. The data of Ormandy, Pond, and Davies(1934) on this system and those of n-propanol with cyclohexane and n-heptane are presented under the hydrocarbons.

n-PROPANOL - C_6H_7N, Aniline, $C_6H_5NH_2$.



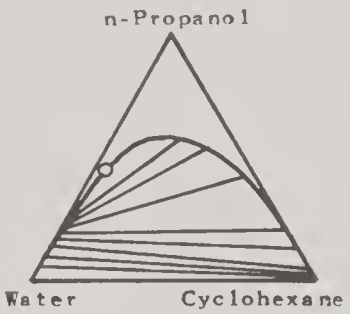
One point on the binodal curve, 31.3% water, 27.0% n-propanol, 41.7% aniline is calculated from the data of Holmes (1918) at 15°. The extremities of the curve, 3.6% and 95.3% aniline result from the data on p. II 406-7.

n-PROPANOL - C_6H_{12}, Cyclohexane

Washburn, Brockway, Graham, and Deming (1942). Compositions in gms. per 100 gms. at 25°.

Lower Layer			Upper Layer		
Water	Propanol	C_6H_{12}	Water	Propanol	C_6H_{12}
94.1	5.8	0.1	0.0	0.9	99.1
91.1	8.6	0.3	0.0	1.4	98.6
85.6	13.9	0.5	0.0	4.4	95.6
81.9	17.5	0.6	0.7	12.1	87.2
79.9	19.3	0.8	1.7	21.3	77.0
78.5	20.8	0.7	6.7	41.6	51.7
77.3	21.9	0.8	12.4	52.6	35.0
75.9	23.0	1.1	18.5	57.8	23.7
57.2	39.6	3.2	49.2	45.7	5.1
-	-	-	52.7	43.01	4.29

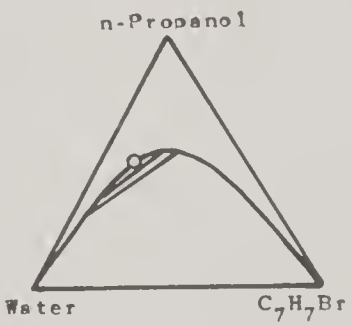
This system is extremely solutropic in the sense that the n-propanol concentration in the upper layer increases thirteen times as fast as in the lower layer over a considerable range. The horizontal tie line is at 18.8% n-propanol. Similar data are presented at 35°.



n-PROPANOL - C_7H_7Br, Bromotoluene (II 206).

The isomer, not identified, is probably largely ortho because the para isomer freezes at 28.5°. The data of Bonner at 0° are recalculated to gms. per 100 gms. solution.

Water	Propanol	C_7H_7Br	
69.3	29.8	0.9	
52.3	41.9	5.8	
42.1	47.4	10.5	
38.1	49.3	12.7	P.P.
28.2	53.0	18.8	
19.3	51.7	29.0	
11.2	43.8	45.0	
6.6	34.2	59.2	
2.6	20.1	77.3	



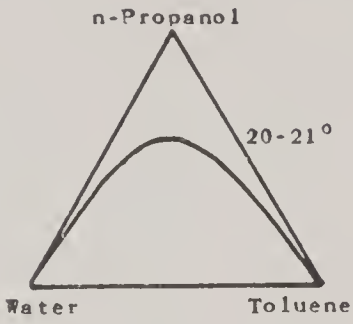
Tie lines. Wt. % n-Propanol in layers

Aqueous	C_7H_7Br
29	52
38	53

PROPANOLS

n-PROPANOL - C_7H_8, Toluene.

The data of Leikola (1940) at 20-21° are recalculated to gms. per 100 gms. solution.



Water	n-Propanol	Toluene
55.8	40.2	4.0
24.6	58.2	17.2
12.6	51.4	36.0
4.2	31.9	63.9

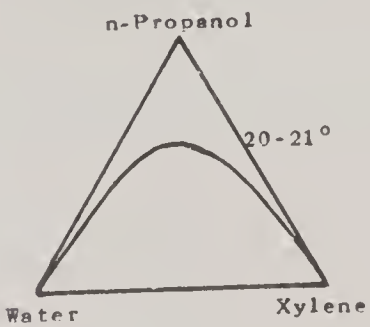
Additional data are reported by Ormandy, Pond, and Davies(1934).

n-PROPANOL - n-Heptane and Gasoline.

Data for these systems are reported under the hydrocarbons.

n-PROPANOL - C_8H_{10}, Xylene.

Leikola's data (1940) at 20-21° are recalculated to gms. per 100 gms. solution.



Water	n-Propanol	Xylene
54.3	41.5	4.2
24.8	57.9	17.3
11.0	52.3	36.7
4.3	31.9	63.8

n-PROPANOL - C_{25} H_{52} Paraffin Wax. (Int. Critical Tables III 401).

n-PROPANOL - $C_{57}H_{104}O_6$, Olive Oil. (Int. Critical Tables III 425).

Distribution only.

n-PROPANOL - Cottonseed Oil (II 206).

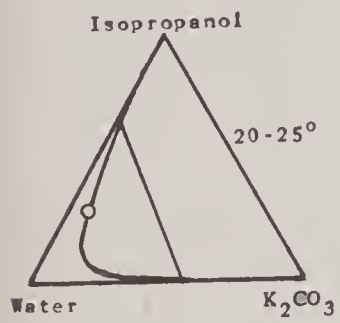
Distribution only.

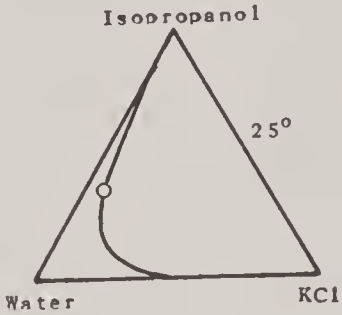
TERNARY AQUEOUS SYSTEMS

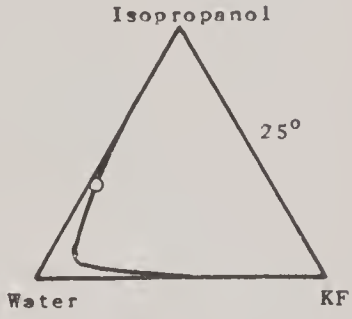
ISOPROPANOL

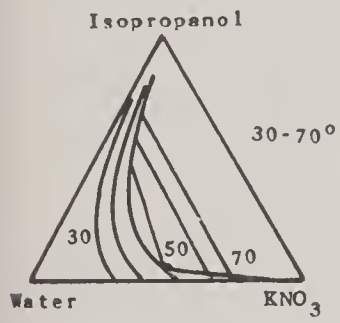
ISOPROPANOL - $(CH_3)_2CHOH$. See CCl_4, CS_2, $CHCl_3$, CH_3NO_2, C_2Cl_4, C_3H_6, $C_4H_8O_2$ (ethyl acetate), $C_4H_{10}O$ (n-butanol), C_6H_{12} (cyclohexane).

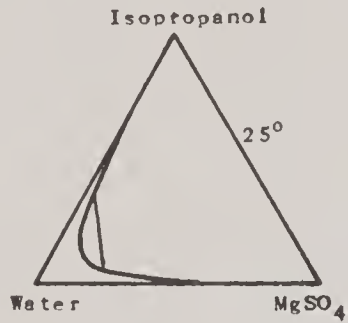
ISOPROPANOL - Salts. K_2CO_3 (I 739), KCl (I 778), KF (I 807), $MgSO_4$ (I 994), $(NH_4)_2HPO_4$ (I 1119), $(NH_4)_2SO_4$ (I 1131), NaBr (I 1162), Na_2CO_3 (I 1212), NaCl (I 1244), $NaNO_3$ (I 1282), KNO_3 and NH_4NO_3 A. R. Thompson and M. C. Molsted, Ind. Eng. Chem. 37, 1244 (1945).

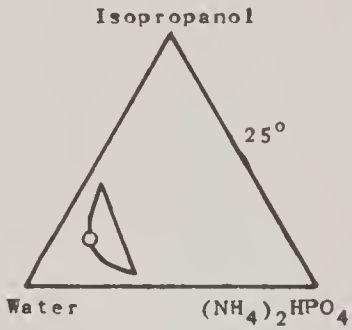


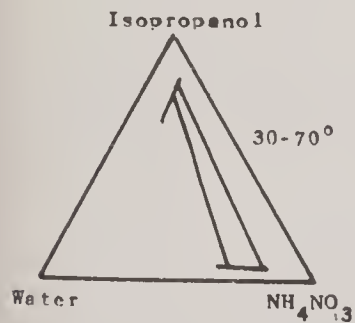


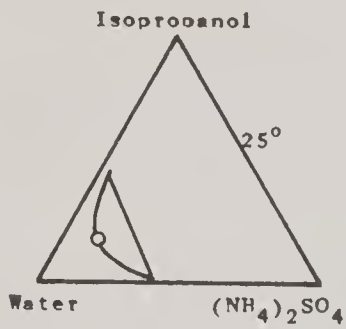


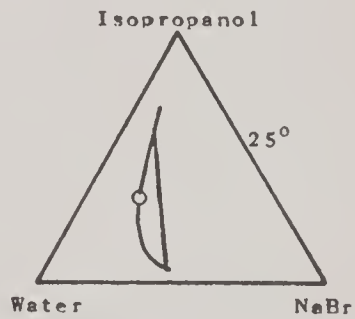


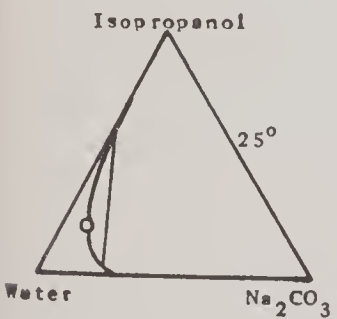


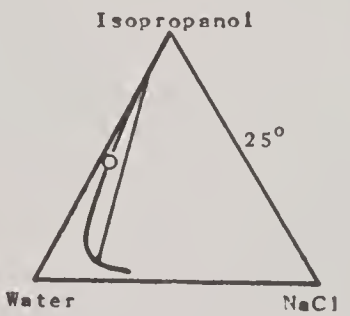


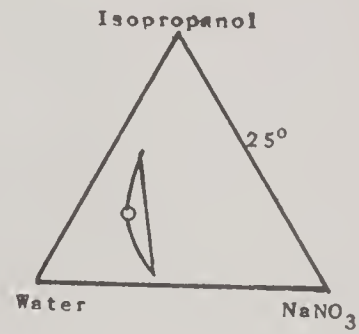






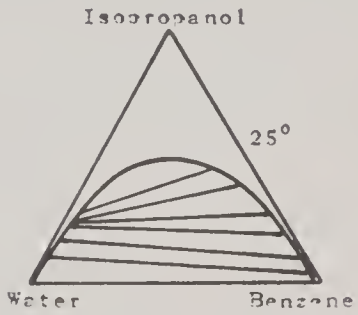






ISOPROPANOL - C_5H_{10}. See Trimethylethylene.

ISOPROPANOL - C_6H_6, Benzene. (II 206-7).



Leikola's data (1940) at 20-21° recalculated to gms. per 100 gms. solution.

Water	Isopropanol	Benzene
62.1	34.5	3.4
33.7	51.0	15.3
17.5	48.5	34.0
5.0	31.6	63.4

Olsen and Washburn (1935) gave the following data for tie lines, in weight percentage of isopropanol in the layers.

Aqueous	Benzene	Aqueous	Benzene	Aqueous	Benzene
2.9	0.8	17.9	8.9	26.7	34.8
5.8	1.5	20.9	15.0	27.9	38.6
8.8	2.3	22.8	19.8	28.5	41.9
11.3	3.3	24.8	26.1	29.7	44.3
14.1	4.9	25.6	30.1	30.2	45.9

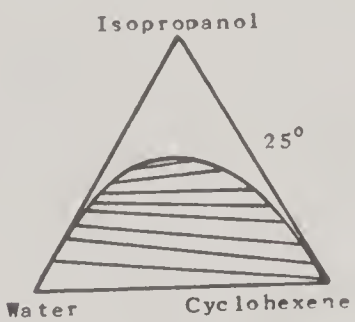
This system is one of the most pronounced solutropes known, with a horizontal tie line at 23.2% isopropanol. Additional data on this system are given by Perrakis (Compt. rend. 177, 880 (1923), and by Ormandy, Pond, and Davies(1934) (see under benzene).

ISOPROPANOL - C_6H_7N, Aniline, $C_6H_5NH_2$.

This system was listed by Mondain-Monval and Quiquarez (1940a) as one containing an isopycnic (tie line connecting compositions of equal density), but no numerical data or curve were given.

ISOPROPANOL - C_6H_{10}, Cyclohexene.

(Washburn, Graham, Arnold, and Transue 1940).



Data are given for 15°, 25°, and 35° which indicate solutropes at each temperature. The horizontal tie lines are at 47.3% isopropanol at 15°, 39.8% at 25°, and 33.4% at 35°.

TERNARY AQUEOUS SYSTEMS

ISOPROPANOL

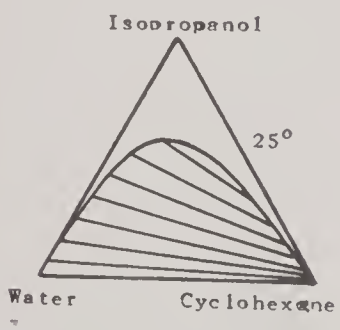
Compositions in gms. per 100 gms. solution at 25°.

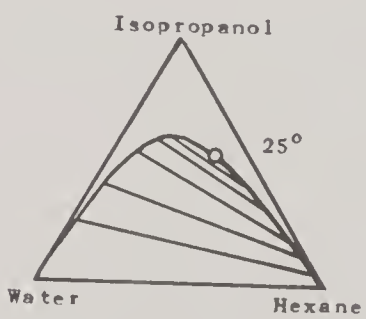
Lower Layer			Upper Layer		
Water	Isopropanol	C_6H_{10}	Water	Isopropanol	C_6H_{10}
91.1	8.8	0.1	0.1	0.6	99.3
79.9	19.8	0.3	0.5	5.7	93.8
69.7	29.6	0.7	1.5	17.6	80.9
63.6	34.9	1.5	3.2	28.8	68.0
60.2	37.5	2.3	5.2	34.2	60.6
55.5	40.4	4.1	8.7	41.3	50.0
47.1	46.0	6.9	18.4	50.2	31.4
41.5	48.3	10.2	27.1	51.6	21.3

ISOPROPANOL - C_6H_{12}, Cyclohexane. (Washburn, Brockway, Graham, and Deming, 1942).

Compositions in gms. per 100 gms. at 25°.

Lower Layer			Upper Layer		
Water	Isopropanol	C_6H_{12}	Water	Isopropanol	C_6H_{12}
95.4	4.4	0.2	0.0	0.0	100.0
92.8	7.1	0.1	0.0	0.2	99.8
84.1	15.4	0.5	0.1	1.3	98.6
73.9	25.9	0.2	0.2	5.9	93.9
66.5	32.6	0.9	0.3	11.2	88.5
55.7	41.6	2.7	1.0	17.2	81.8
39.9	52.1	8.0	2.8	25.8	71.4
26.7	55.5	17.8	5.4	33.5	61.1
-	-	-	7.12	37.86	55.02
19.62	53.53	26.85	-	-	-
-	-	-	11.36	45.08	43.56
14.74	49.29	35.97	-	-	-





ISOPROPANOL - C_6H_{14}, n-Hexane (Francis, 1950).

Compositions in gms. per 100 gms. solution.

Lower Layer			Upper Layer		
Water	Isopropanol	Hexane	Water	Isopropanol	Hexane
76	24	0	0	6	94
59	40	1	0.5	13.5	86
43	52	5	1	20	79
29	58	13	3	32	65
20	59	21	7	43	50
13	53	34		Plait Point	

ISOPROPANOL - $C_6H_{14}O$, Isopropyl Ether. (I. L. Krupatkin and M. A. Bodin, J. Gen. Chem., (U.S.S.R) 17, 1993, 1947).

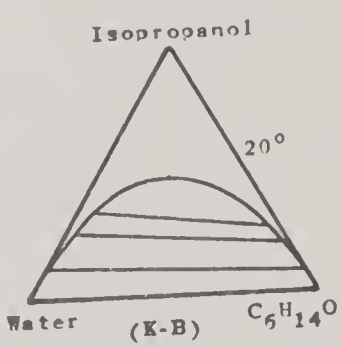
Compositions in gms. per 100 gms. solution.

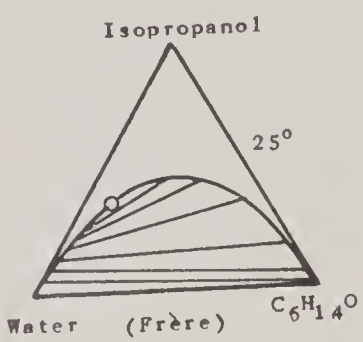
Temperature 20°			Temperature 60°		
Water	Isopropanol	$C_6H_{14}O$	Water	Isopropanol	$C_6H_{14}O$
93.4	5.5	1.1	93.9	5.7	0.4
74.0	24.6	1.4	74.4	23.1	2.5
65.8	30.0	4.2	55.6	36.3	9.2
41.9	41.4	16.7	34.2	44.4	21.4
24.2	43.1	32.7	20.8	41.8	37.4
14.2	35.8	50.0	14.6	32.7	52.7
8.0	23.8	65.4[a]	10.0	19.3	70.7

(a) Add to only 97.2%

Tie lines; Wt. % of isopropanol in layers at 20°.

Aqueous	Ether
13	7
24	18
35	28





ISOPROPANOL - Isopropyl Ether (cont.).

F. J. Frère, Ind. Eng. Chem. 41, 2365 (1949).

Gms. per 100 gms. at 25°

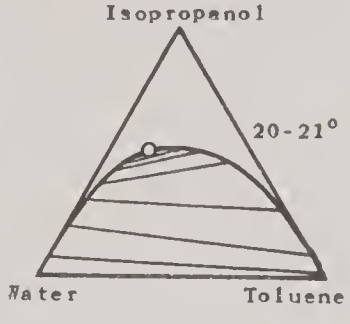
Lower Layer			Upper Layer		
Water	Isopropanol	$C_6H_{14}O$	Water	Isopropanol	$C_6H_{14}O$
92.1	6.9	1.0	0.8	2.8	96.4
86.9	11.9	1.2	1.5	8.4	90.1
82.4	16.3	1.3	4.0	19.7	76.3
77.8	20.5	1.7	10.2	35.6	54.2
71.2	25.9	2.9	18.7	44.4	36.9
64.6	30.7	4.7	29.0	45.7	25.3
53.3	36.9	9.8		Plait Point	

Two graphs are shown because this system is one of the few in which there is a serious discrepancy in data on tie lines. These are shown sloping in opposite directions. Some observations by the compiler are in substantial agreement with those of Frère, which indicate a solutrope with a horizontal tie line at about 14% isopropanol.

ISOPROPANOL - C_7H_8, Toluene.

Leikola's data (1940) at 20-21° recalculated to gms. per 100 gms. solution.

Water	Isopropanol	Toluene
55.7	40.3	4.0
46.3	44.7	9.0
33.5	51.1	15.4
25.9	49.4	24.7
18.5	47.9	33.6
7.4	37.0	55.6
4.8	31.7	63.5



(E. R. Washburn and A. E. Beguin, J. Am. Chem. Soc., 62, 579, 1940). Same units.

Lower Layer			Upper Layer		
Water	Isopropanol	Toluene	Water	Isopropanol	Toluene
93.12	6.87	0.01	0	0.89	99.11
79.95	19.77	0.28	0.71	7.45	91.84
69.98	29.00	1.02	3.20	24.90	71.90
59.64	37.40	2.96	11.42	44.23	44.35
32.32	42.10	5.58	17.45	49.95	32.60
44.00	46.50	9.50	25.24	51.20	23.56

The system is solutropic with a horizontal tie line at 32.15% isopropanol. Additional data on this system from Ormandy, Pond, and Davies (1934) are given under toluene.

ISOPROPANOL - C_7H_9N, o-Toluidine, $CH_3C_6H_4NH_2$.

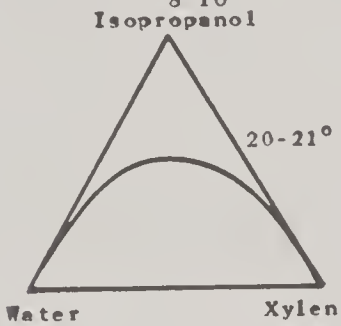
Mondain-Monval and Quiquarez (1940) listed this system as one containing an isopycnic (tie line connecting compositions having equal densities), but gave no graph nor numerical data.

ISOPROPANOL - C_7H_{16}, n-Heptane. See C_7H_{16}.

ISOPROPANOL - Gasoline (I 588).

Water tolerance of isopropanol gasoline mixtures. Cf. also Ormandy, Pond, and Davies (1934).

ISOPROPANOL - C_8H_{10}, Xylene.



Leikola's data (1940) at 20-21° recalculated to gms. per 100 gms. solution.

Water	Isopropanol	Xylene
52.2	43.5	4.3
30.5	53.5	16.0
18.3	48.1	33.6
5.4	31.6	63.0

ISOPROPANOL - Butyltoluene, $C_4H_9C_6H_4CH_3$.

This system was listed by Mondain-Monval and Quiquarez (1940) as one containing an isopycnic or tie line connecting compositions having equal densities. No graph or numerical data were presented.

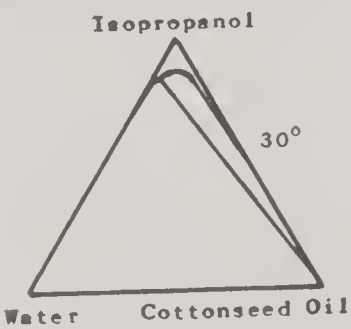
ISOPROPANOL - $C_{57}H_{104}O_6$, Olive Oil.

(Int. Critical Tables, III 425). Distribution.

ISOPROPANOL - Cottonseed Oil.

(Harris, Bishop, Lyman, and Helpert, J. Am. Oil Chemists Soc., 24, 370 (1947).

Compositions in gms. per 100 gms. solution at 30°, taken from a graph.

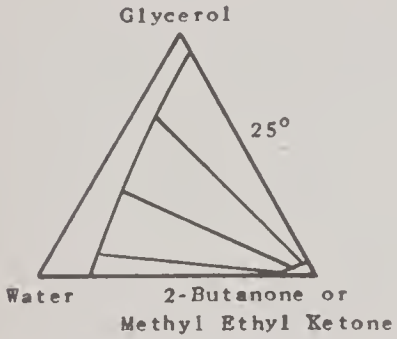


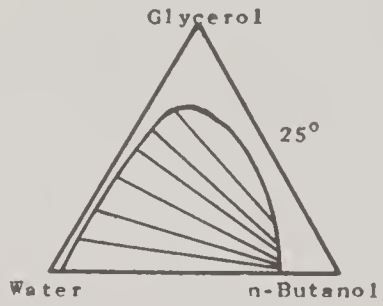
Water	Isopropanol	Oil
12.5	85.0	2.5[a]
9	86	5
5	83	12
2.5	72.5	25
2	48.5	49.5
0.5	12.5	87[a]

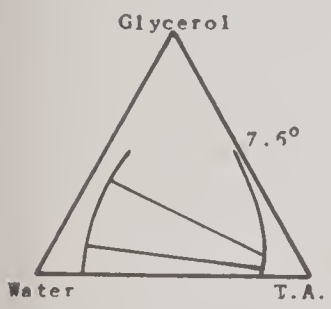
(a) Compositions in equilibrium.

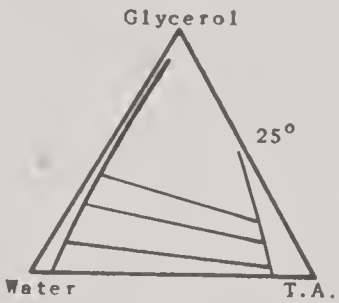
$C_3H_8O_3$, Glycerol, $CH_2OHCHOHCH_2OH$.

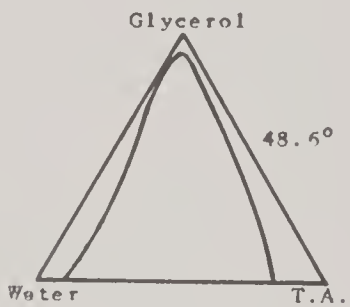
J. C. Elgin (U. S. Patent 2,479,041 (1949) studied several glycerol systems. The one with acetone is illustrated and discussed above under acetone. The others are shown below. No numerical data were presented.





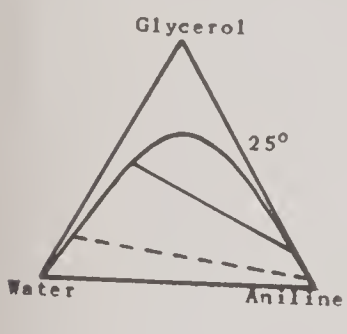


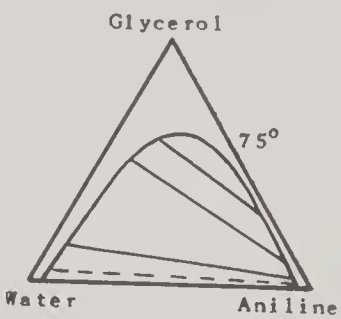


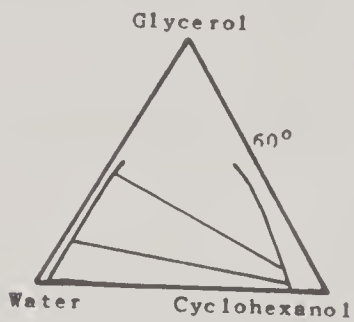


T.A. = tert-Amyl Alcohol, $C_2H_5COH(CH_3)_2$.

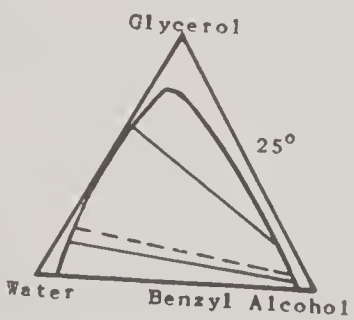
These three graphs are given also in U. S. Patent 2,436,209 (1948).

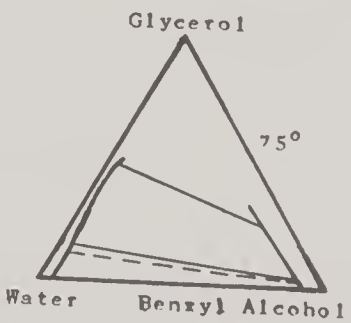






For aniline Cf. also II 415.

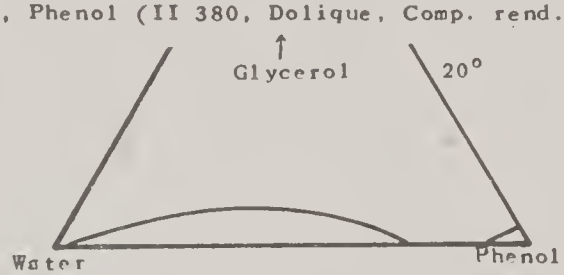




Four of these glycerol systems have isopycnics (dashed tie lines) connecting compositions having equal densities (positions estimated by compiler). Some of the graphs contain unexpectedly wavy or concave curves. These may result from uncertainties due to extremely slow settling, since the mixtures are very viscous.

Three of the graphs, those of n-butanol, cyclohexanol, and the one of tert-amyl alcohol at 7.6°, have tie lines so steep that when extended they would intersect the base line. One of these has been confirmed experimentally by the compiler. They are of interest because they involve negative selectivity. That is, although glycerol is miscible with tert-amyl alcohol and water is not, yet under some conditions the raffinate contains a higher ratio of glycerol to water than does the extract. No other such systems seem to be published. Systems with tie lines pointing exactly toward a corner (isologous lines) have been called "azeotropic", because under those conditions there is zero selectivity. This is in contrast with "solutropic" with a horizontal tie line.

GLYCEROL - C_6H_6O, Phenol (II 380, Dolique, Comp. rend. 194, 289 (1932).



Corrections: On p. II 209 the title of the next to the last table should read "Reciprocal Solubility of Glycerol and Pyrocatechol Monoethyl Ether" (same change in table). In the bottom table the words "No separation between" apply only to 35° and 80° in the first column and 35.0 and 90.0 in the second column; and the symbols < and > should precede 28.57 and 77.40 respectively.

C_3H_9N, Trimethyl Amine $(CH_3)_3N$ (II 211-2).

Distributions between water and chloroform, ether, benzene, toluene, xylene, or ethylbenzene.

C_3H_9N, - n-Propyl Amine $C_3H_7NH_2$ (II 197, 213).

Distributions between water and toluene or xylene.

C_4HN_3 - Cyanoform $CH(CN)_3$. $C_4H_{10}O$, Ether.

A. Hantzsch and G. Osswald, Ber. 32, 641 (1899). The system gives three liquid layers of which one has the composition of 17.8% water, 73.29% ether, 9.01% cyanoform. The other data are missing.

$C_4H_2O_4Na_2$ - Sodium Maleate, $COONaCH:CHCOONa$ - $C_4H_{10}O$, Ether (II 276).

Salting out

$C_4H_4N_2$: Succinonitrile or Ethylene Cyanide, $(CH_2CN)_2$. See C_2H_6O, Ethanol. p. 909

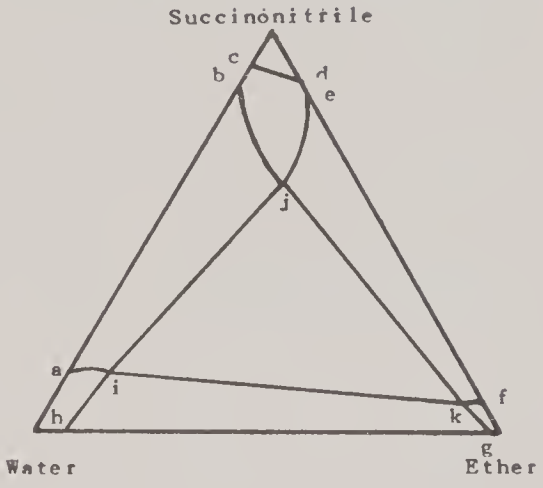
Succinonitrile - chloroform $(CH_2CN)_2$-$CHCl_3$ (II 214).

Distribution.

SUCCINONITRILE - $C_4H_{10}O$, Ether. (II 214).

F. A. H. Schreinemakers, Z. Physik Chem., 25, 543 (1898).

This system gives three liquid layers of compositions i, j, and k, and is cited in most physical chemistry text books. Schreinemakers' data were in mole per cent and his graph was schematic and distorted. Some of the text books have further distorted the graph almost beyond recognition. The compiler has observed the system experimentally with substantial agreement with Schreinemakers except that all of the binodal curves ai, hi, bj, ej, fk, and gk seem to be substantially straight as well as the curve cd in equilibrium with solid nitrile.



In the following table Schreinemakers' data are recalculated to gms. per 100 gms. mixture at 25°. Francis' data are in parentheses.

Point	Water	Nitrile	Ether	Point	Water	Nitrile	Ether
a	86	14	0	h	94	0	6
b	11	89	0	i	80	14	6
c	9	91	0		(83)	(10)	(7)
d	0	88	12	j	15	63	22
e	0	85	15		(13)	(58)	(29)
f	0	6	94	k	3	7	90
g	1.4	0	98.6		(5)	(9)	(86)

SUCCINONITRILE - Salts. Int. Critical Tables III. $AgNO_3$ p. 414. NaCl, $NaNO_3$ p. 419.

SUCCINONITRILE - Benzoic Acid (II 509 ref.).

SUCCINONITRILE - Naphthalene, Benzil, Mannitol, Cane Sugar, Camphor, Azobenzene (Timmermans 1907). Fragmentary data.

C_4H_4O - Furane, $\begin{matrix}CHCH\\CHCH\end{matrix}\!\!>\!O$ - Lactic Acid. Listed with Acetic Acid.

$C_4H_4O_4$ - Maleic and Fumaric Acids, COOH·CH:CH·COOH. $C_4H_{10}O$, Ether (II 216).

Distribution. Maleic acid goes mostly to the aqueous layer, but the fumaric acid system is solutropic, with a horizontal tie line at about 0.5% acid in each layer.

$C_4H_4O_4Br_2$ - Dibromosuccinic Acid, $(CHBrCOOH)_2$ - $C_4H_{10}O$, Ether (II 219 ref.).

$C_4H_4O_4Na_2$ - Sodium Succinate, $(CH_2COONa)_2$, Ether (II 275), Isoamyl Alcohol (II 315), Phenol (Schryver 1910).

$C_4H_4O_5Na_2$ - Sodium Malate, $NaOOCCHOHCH_2COONa$.

Distribution between water and phenol. (Schryver 1910).

$C_4H_4O_6Na_2$, Sodium Tartrate - $(CHOHCOONa)_2$.

See $C_4H_{10}O$, tert Butanol, $C_4H_{10}O$ Ether (II 275); $C_5H_{12}O$, Isoamyl Alcohol (II 315); C_6H_6O Phenol (Schryver 1910).

$C_4H_4O_6NaK$ - Rochelle Salt. $NaOOCCHOHCHOHCOOK$. See $C_4H_{10}O$ tert-Butanol.

$C_4H_5OCl_3$ - Trichlorobutyraldehyde, $CH_3CHClCCl_2CHO$ - 'Oil' (II 219).

$C_4H_5O_2Cl_3$ - $\alpha\ \alpha\ \beta$ - Trichlorobutyric Acid, $CH_3CHClCCl_2COOH$.

Benzene (II 220). Pentene and Benzene. (W. Nernst and C. Hohman, Z. physik. Chem., 11, 352 (1893)). Gms. per 100 gms. of the two layers. (two separate systems, water-pentene and water-benzene).

Water	Pentene	Benzene
1.8	0.6	1.1
2.4	1.1	2.1
4.5	2.6	11
5.05	3.2	17.2

The water-benzene system is solutropic, with a horizontal tie line at about 3% acid.

$C_4H_5O_2Cl_3$ - Ethyl Trichloroacetate, $CCl_3COOC_2H_5$ Ethanol (II 238).

Data listed under Ethanol.

$C_4H_5O_4Br$ - Bromosuccinic Acid, $HOOCCH_2CHBrCOOH$ (II 219)

Distribution between water and ether or xylene.

Correction: The other table should be Acetone and Glycerol instead of Water and Glycerol.

C_4H_6 - 1, 3-Butadiene, CH_2:CHCH:CH_2.

A. S. Smith and Braun (1945) indicated selectivities of dilute methanol for Butadiene with respect to 2-butene and isobutene. Holloway and Thurber (1944) gave some data on vapor pressures of aqueous solutions of butadiene. McBain and O'Connor (1941) showed enhancement in solubility of butadiene and isobutane in water by 1% potassium oleate.

$C_4H_6O_2$ - α - Crotonic Acid - CH_3CH:CHCOOH.

Distribution between water and chloroform, ether, benzene, toluene, or xylene (II 221-2). The systems with benzene and toluene at least are solutropic with horizontal tie lines.

$C_4H_6O_2$ - Vinyl Acetate, CH_3COOCH:CH_2. See C_2H_4O, Acetaldehyde, $C_2H_4O_2$, Acetic Acid, C_3H_6O, Acetone.

$C_4H_6O_2Cl_2$ - Ethyl Dichloroacetate - C_2H_6O, Ethanol (II 238). See C_2H_6O.

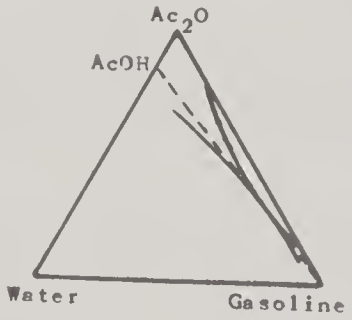
$C_4H_6O_3$ - Acetic Anhydride, $(CH_3CO)_2O$. See CS_2.

Acetic Anhydride - "Benzine" or Gasoline. (R. V. Mertslin, Bull. Acad. Sci. (U.S.S.R.) 1937, 1407; Chem. Abstr. 32, 5689. Gms. per 100 gms. mixture at 25°.

Lower Layer			Upper Layer		
Water	Ac_2O	Gasoline	Water	Ac_2O	Gasoline
0	88.7	11.3	14.2	70.8	15.0
5.2	78.3	16.5	12.1	59.9	28.0
6.9	66.7	24.4[b]	7.0	38.0	55.0
7.5	56.5	36.0	3.0	17.0	80.0
5.6	37.7[a]	56.7	2.4	15.1	82.5
4.0	24.0	72.0	1.5	14.0	84.5
0	10.7	89.3			

(a) The original gives 62.3, a typographical error.
(b) Add to only 98%.

Similar data are given at 15°, 20°, 30°. As in the carbon disulfide-acetic anhydride system (q.v.) the graph shows only a quasi-equilibrium, which varies with the time allowed for observation. With no hydration of the acetic anhydride three layers result. With complete hydration there are two separate binodal curves (really two distinct systems) since acetic acid is miscible with gasoline. The isologous line (dashed line) from the gasoline corner to the composition of acetic acid (85% acetic anhydride) divides the triangle into two simple ternary diagrams.

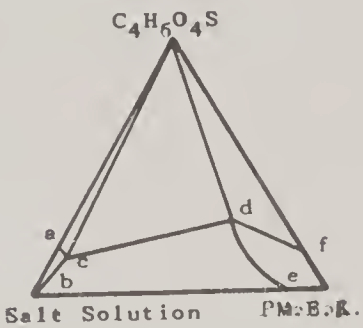


$C_4H_6O_4$ - Succinic Acid, $(CH_2COOH)_2$.

Distribution between water and chloroform (II 229), ether (II 229, 276), isoamyl alcohol (II 230), phenol (II 230, 389), amyl ether (II 229), n-amyl alcohol (G. F. Asselin and E. W. Comings, Ind. Eng. Chem. 42, 1205 (1950)).

Corrections: In the second table of II 230 Gm. Mols. should be Gm. equivalents (half as much). The item 1.208 should be 1.268.

$C_4H_6O_4S$ - Thiodiacetic Acid, $S(CH_2COOH)_2$ - 2-Butanone or Methyl Ethyl Ketone (M.E.K.) with an aqueous salt solution containing 11.43% NaCl and 14.84% Na_2SO_4. (J. W. Clegg and E. A. Bearse, Ind. Eng. Chem. 42, 1224, 1950).

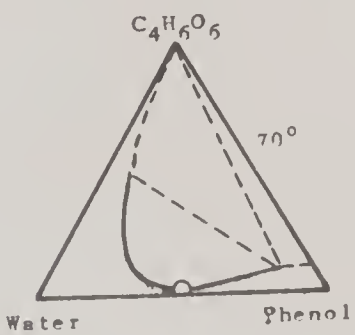


Compositions of points in gms. per 100 gms. mixture at 25°: a 17.87% acid; b 2.10% M.E.K.; c 11% acid and 3% M.E.K. (from graph); d 32% acid and 47% M.E.K. (from graph); e 10.4% aqueous solution; f 13.2% acid.

$C_4H_6O_5$ - Malic Acid, $HOOC\cdot CHOHCH_2COOH$.

Distribution between water and ether (II 232).

$C_4H_6O_6$ - Tartaric Acid, $(CHOHCOOH)_2$.



Distribution between water and ether (II 235-6), isoamyl alcohol (II 235), phenol (II 379, 389). The last gives fragmentary data at temperatures 30° to 97° from which the binodal curve at 70° is plotted. The positions of the dotted lines are conjectural.

$C_4H_7O_2Br$ - α- Bromobutyric Acid, $CH_3CH_2CHBrCOOH$.

Distribution between water and chloroform, benzene, toluene, or olive oil (II 238). The first three of these systems are solutropic (with horizontal tie lines). In the tables "$CHCl_3$" was inadvertently used to head the column for each nonaqueous layer.

$C_4H_7O_2Cl$ - Ethyl Chloroacetate, $CH_2ClCOOC_2H_5$ (II 238). See C_2H_6O.

$C_4H_7O_2Cl_3$ - Butyrochloral Hydrate, $CH_3CHClCCl_2CH(OH)_2$.

Distribution between water and olive oil (II 218).

$C_4H_7O_2K$ - Potassium Isobutyrate $(CH_3)_2CHCOOK$. See isobutyric acid, p. 990

$C_4H_7O_2Na$ - Sodium Butyrate, $CH_3CH_2CH_2COONa$. Salting in effect on ethyl acetate (II 247), isoamyl alcohol (II 315), aniline (II 410), nitrobenzene (Int. Critical Tables III 402 ref.).

C_4H_8 - 1-Butene, $CH_2:CHCH_2CH_3$. See NH_3 - $C_5H_4O_2$, furfural

C_4H_8 - Isobutene, $(CH_3)_2C:CH_2$. See C_4H_6, butadiene.

$C_4H_8Cl_2S$ - Dichloroethyl Sulfide, $(ClCH_2CH_2)_2S$ (Mustard gas) (II 242).

Solubility in absolute and 92.5% ethanol.

C_4H_8O,- 2-Butanone or Methyl Ethyl Ketone (M.E.K.).

See CS_2, formic acid, acetic acid, ethanol, glycerol, thiodiacetic acid.

Methyl Ethyl Ketone - C_2HCl_3, Trichloroethylene; $C_2H_3Cl_3$ Trichloroethane; C_6H_5Cl, Chlorobenzene; $C_6H_{14}O_2$, Butyl Cellosolve, $CH_3CH_2CH_2CH_2OCH_2CH_2OH$ (B.C.). (M. Newman and C. B. Hayworth, Ind. Eng. Chem. 41, 2039, 1949).

Compositions in gms. per 100 gms. solution at 25°.

Aqueous Layer			Organic Layer		
Water	M.E.K.	C_2HCl_3	Water	M.E.K.	C_2HCl_3
75.6	24.4	-	10.0	90.0[a]	-
83.68	16.10	0.22	3.04	71.65	25.31
88.65	11.03	0.32	0.22	58.10	41.68
92.87	6.75	0.38	0.18	22.10	77.72

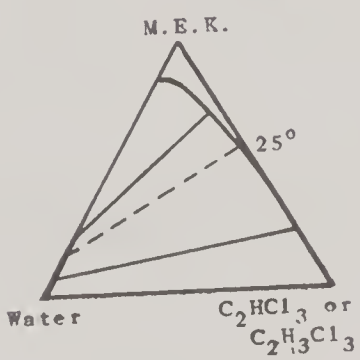
(a) This pair of conjugate liquids is included in all four systems. In that for chlorobenzene (Table VII, top of p. 2043) the value 40.0% M. E. K. should be 90.0%.

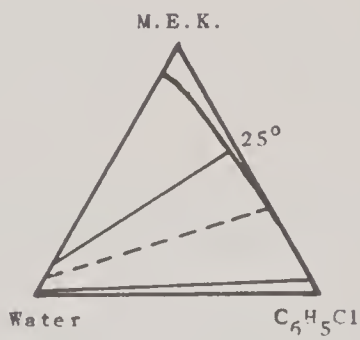
TERNARY AQUEOUS SYSTEMS

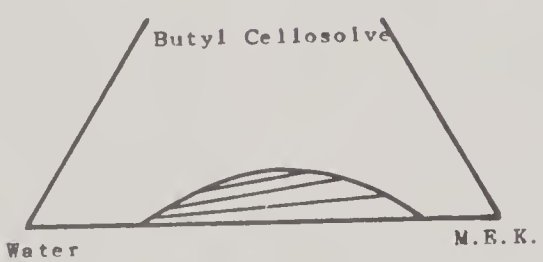
METHYL ETHYL KETONE

Aqueous Layer			Organic Layer		
Water	M.E.K.	$C_2H_3Cl_3$	Water	M.E.K.	$C_2H_3Cl_3$
87.06	12.78	0.16	2.73	58.62	38.65
93.70	6.00	0.30	1.00	31.20	67.80
98.57	1.02	0.41	0	5.58	94.42
		C_6H_5Cl			C_6H_5Cl
86.82	13.10	0.08	2.14	58.58	39.28
92.19	7.65	0.16	0.40	29.65	69.95
96.08	3.64	0.28	0.24	8.58	91.18
Water	B.C.	M.E.K.	Water	B.C.	M.E.K.
72.4	1.9	25.7	18.8	5.8	74.4[a]
67.3	4.0	28.7	29.7	11.2	59.1
59.2	7.1	33.7	38.1	12.2	49.7

a. Adds to only 99.0%.







The three systems with chlorine compounds have isopycnics (dashed lines) or tie lines connecting compositions having equal densities, (positions estimated by compiler).

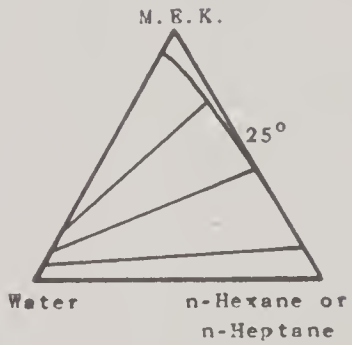
METHYL ETHYL KETONE - $C_3H_6O_2$ - Propionic Acid (II 189) and $C_4H_8O_2$, n-Butyric Acid (II 256). Distributions.

METHYL ETHYL KETONE - C_6H_{14}, n-Hexane and C_7H_{16}, n-Heptane.

(R. E. Treybal and O. J. Vondrak, Ind. Eng. Chem. 41, 1761 1949).

Compositions in gms. per 100 gms. mixture at 25°.

Lower Layer (Hexane Negligible)		Upper Layer		
Water	M.E.K.	Water	M.E.K.	Hexane
93.80	6.20	0.0	11.0	89.0
87.27	12.73	0.4	41.79	57.81
83.02	16.98	2.0	69.51	28.49
-	-	4.20	89.45	15.35
-	-	6.34	86.36	7.3
75.60	24.40	10.0	90.0	0.0



(Heptane Negligible)

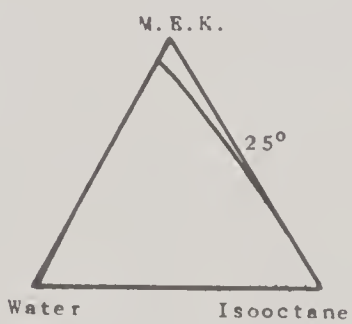
Water	M.E.K.	Water	M.E.K.	Heptane
92.19	7.81	0.0	12.09	87.91
85.08	14.92	0.1	40.73	59.17
80.63	19.37	1.0	74.81	24.19
-	-	3.68	82.17	14.15
-	-	7.20	86.55	6.25
75.60	24.40	10.00	90.00	0.0

METHYL ETHYL KETONE - C_8H_{18} - Isooctane or 2.2.4 Trimethyl Pentane.

(Moulton and Walkey, 1944).

Compositions in gms. per 100 gms. layers at 25°.

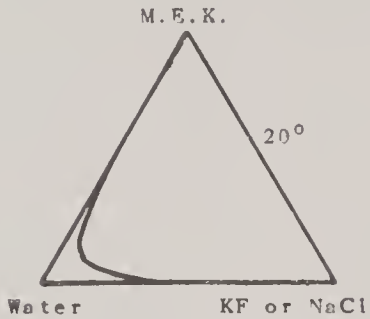
Lower Layer (Isooctane Negligible)		Upper Layer		
Water	M.E.K.	Water	M.E.K.	C_8H_{18}
74.7	25.3	12.5	87.5	0
81.4	18.6	3.4	75.0	21.6
83.5	16.5	1.9	60.6	37.5
84.8	15.2	1.0	48.6	50.4
88.1	11.9	0.3	26.4	73.3
92.3	7.7	0.1	12.1	87.8



Data are given also for gasoline which are almost identical. The gasoline had a boiling range of 86° to 135°C. A.P.I. Gravity 55.4, Aniline Pt. 65.6°C.

METHYL ETHYL KETONE - HNO_3, Nitric Acid (I 583, ref.).

METHYL ETHYL KETONE - KF (I 807); NaCl (I 1242).



Meissner and Stokes (1944) showed that methyl ethyl ketone is salted out of water by the following salts in decreasing order of effectiveness:

LiCl, CH_3COOK, $CaCl_2$, $MgCl_2$, NaCl, CH_3COONa, Li_2SO_4, $MgSO_4$.

METHYL ETHYL KETONE - Olive Oil (Int. Crit. Tables III 426).

Distribution.

C_4H_8O, Ethyl Vinyl Ether. See Ethanol.

$C_4H_8O_2$, Ethyl Acetate - $CH_3COOC_2H_5$(EtOAc).

See I_2, H_2O_2, methanol, urea, acetic acid, ethanol, acetone, lactic acid (with acetic acid), vinyl pyrrolidone (C_6H_9ON).

ETHYL ACETATE - Salting out with 40 salts and four sugars (II 246-7), Euler (1899). $HgCl_2$ (I 629), HgI_2 (I 644).

ETHYL ACETATE - C_4H_8O, n-Propanol and Isopropanol and $C_4H_{10}O$, all four Butanols.

(D. G. Beech and S. Glasstone, J. Chem. Soc. 1938, 70).

Compositions in gms. per 100 gms. solution at 20°.

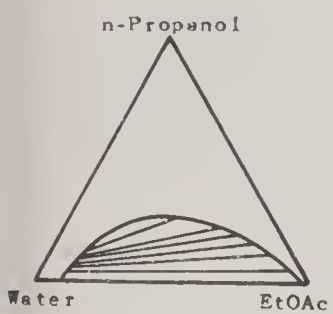
Lower Layer			Upper Layer		
Water	nPrOH	EtOAc	Water	n-PrOH	EtOAc
88.7	3.5	7.8	4.2	5.4	90.4
85.9	6.1	8.0	7.6	12.0	80.4
84.0	7.7	8.3	11.3	17.2	71.5
81.3	9.7	9.0	17.9	23.7	58.4
79.0	11.3	9.7	23.7	26.7	49.6
72.6	15.2	12.2	34.7	28.8	36.5

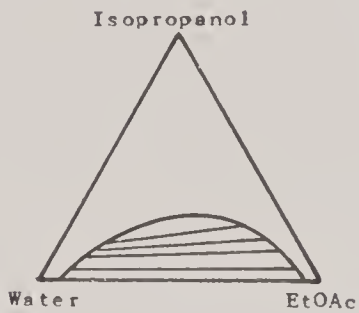
TERNARY AQUEOUS SYSTEMS

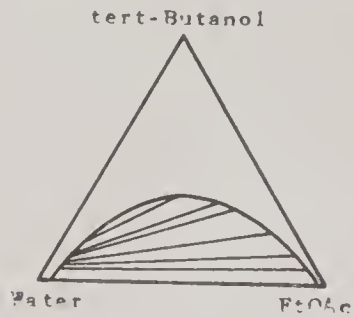
$C_4H_8O_2$

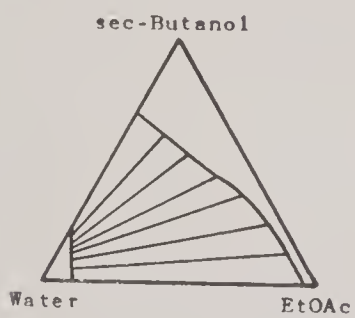
ETHYL ACETATE

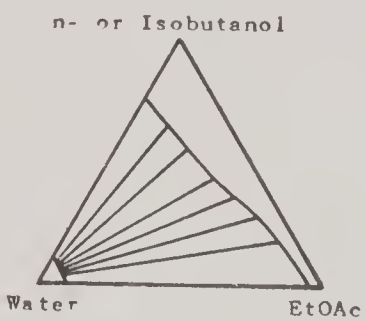
Lower Layer			Upper Layer		
Water	i-PrOH	EtOAc	Water	i-PrOH	EtOAc
88.7	3.4	7.9	4.2	4.1	91.7
82.0	8.8	9.2	8.4	11.8	79.8
78.2	11.8	10.0	12.3	16.4	71.3
74.0	14.6	11.4	18.8	21.8	59.4
69.5	16.8	13.7	26.6	25.1	48.3
Water	t-BuOH	EtOAc	Water	t-BuOH	EtOAc
88.9	3.5	7.6	5.0	6.1	88.9
86.8	5.7	7.5	7.7	12.9	79.4
84.3	8.3	7.4	11.4	20.6	68.0
81.5	10.8	7.7	17.4	28.4	54.2
79.8	12.4	7.8	22.6	31.9	45.5
75.5	15.7	8.8	35.7	33.8	30.5











Water	s-BuOH	EtOAc	Water	s-BuOH	EtOAc
89.8	3.0	7.2	5.2	12.1	82.7
88.9	4.3	6.8	9.0	21.8	69.2
88.5	5.0	6.5	13.1	30.9	56.0
86.5	8.2	5.3	17.7	39.0	43.3
85.4	10.4	4.2	23.6	47.6	28.8
83.7	13.7	2.6	30.5	56.4	13.1

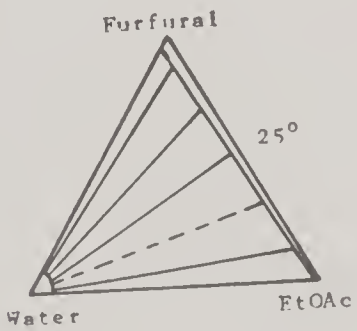
ETHYL ACETATE

Lower Layer			Upper Layer		
Water	Isobutanol	EtOAc	Water	Isobutanol	EtOAc
90.8	1.9	7.3	6.5	14.1	79.4
90.6	2.5	6.9	9.5	24.9	65.6
89.9	3.8	6.3	11.4	31.6	57.0
90.0	5.2	4.8	14.2	43.1	42.7
90.3	6.1	3.6	16.2	53.7	30.1
91.1	6.9	2.0	17.7	67.3	15.0
Water	n-Butanol	EtOAc	Water	n-Butanol	EtOAc
92.0	1.7	6.3	7.0	14.4	78.6
92.0	2.2	5.8	10.7	25.99	63.4
92.1	2.6	5.3	13.3	32.7	54.0
92.2	3.6	4.2	16.2	42.3	41.5
92.4	4.2	3.4	18.3	53.1	28.6
93.0	5.2	1.8	19.6	66.1	14.3

Similar data are given at 0° for all six alcohols as well as methanol (II 45, 46) and ethanol (II 134). The systems with the propanols and tert-butanol are solutropes (with horizontal tie lines) at 0° but not at 20°. The other three butanols have bands with concave borders. Such concave binodal curves are possible when the tie lines are nearly normal to the curve, but not at points near a plait point (tie lines almost parallel). The concave bands suggest that they might break into two separate curves with rising temperature.

ETHYL ACETATE - $C_5H_4O_2$, Furfural (II 248).

(Trimble and Dunlop, 1940).



Gms. per 100 gms. mixture		
Water	Furfural	EtOAc
91.5	2.7	5.8
90.9	5.8	3.3
3.8	11.0	85.2
4.8	51.3	43.9
5.2	88.0	6.8

The tie lines are practically isologous (pointing toward one corner) so that water would have no selectivity between furfural and ethyl acetate. Ethyl acetate is effective in extracting furfural from water solution, however. The binodal curve near the water corner is concave, which is unusual but possible when not close to a plait point. The dashed line is an isopycnic connecting compositions of equal density (position estimated by compiler). Corrections: On p. 248, last item of table instead of "94.76" read "96.76". Instead of "adjoining" read "pairs of conjugate".

ETHYL ACETATE - Petroleum Ether, Benzene, or Gasoline.

Distribution. (Philip and Bramley, 1915; Int. Critical Tables III, 426).

ETHYL ACETATE - C_6H_7N, Aniline (II 417).

Distribution of aniline between ethyl acetate and water or sodium oleate solutions.

ETHYL ACETATE - Olive Oil. (Int.Critical Tables III 426).

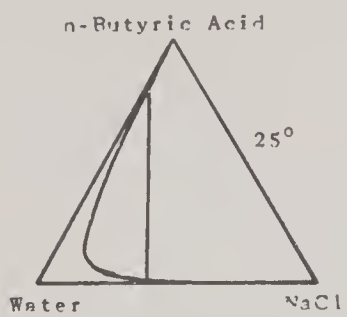
Distribution.

$C_4H_8O_2$ - Methyl Propionate and n-Propyl Formate.

See Ethanol.

$C_4H_8O_2$ - n-Butyric Acid - $CH_3CH_2CH_2COOH$. See CCl_4, $CHCl_3$, CS_2.

n-Butyric Acid- NaCl, Sodium Chloride (I 1245).



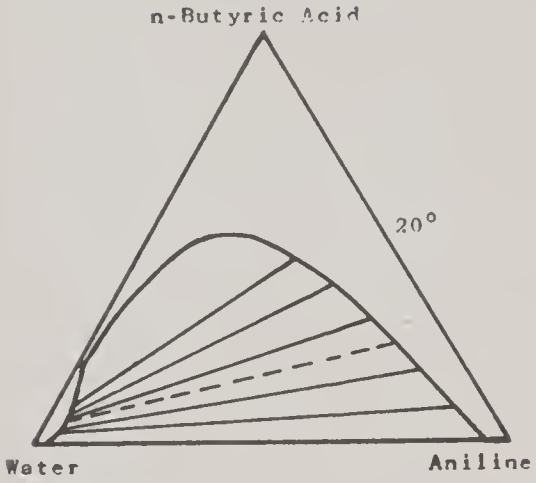
n-Butyric Acid - Salting out of water by nine substances of various classes (II 258, ref.).

Distributions of n-butyric acid between water and methyl ethyl ketone (2-butanone) (II 256), n-butanol, sec.-butanol, and isobutanol (II 256), ether (II 251, 256), n-amyl alcohol (II 255, 256), isoamyl alcohol (II 255), tert-amyl alcohol (II 256), petroleum ether (II 257), nitrobenzene (II 255), benzene (II 253, 254), isopropyl ether (II 256), o-nitrotoluene (II 257), xylene (II 252), olive oil (II 257), cottonseed oil (II 252), toluene (II 253, 256).

At least seven of the n-butyric acid systems are solutropic, that is, have horizontal tie lines. In several of them the tie lines extend to such high concentrations, 4.8 to 6.9 moles per liter of the organic layer as to suggest that the apex of the curve was reached, but there is no proof of this in the publication.

n-BUTYRIC ACID

n-BUTYRIC ACID - Aniline. (Angelescu and Cristodulo 1940).



Gms. per 100 gms. mixture at 20°

Water	Butyric Acid	Aniline
96.52	-	3.48
88.41	5.73	5.86
80.53	16.15	3.32
70.92	25.00	4.08
61.11	33.47	5.42
51.19	41.63	7.18
42.02	48.25	9.73
33.82	51.78	14.90
26.51	49.83	23.66
21.63	44.04	34.33
16.86	34.90	48.24
12.81	25.54	61.65
9.14	17.84	73.02
5.76	6.52	87.72
4.45	-	95.55

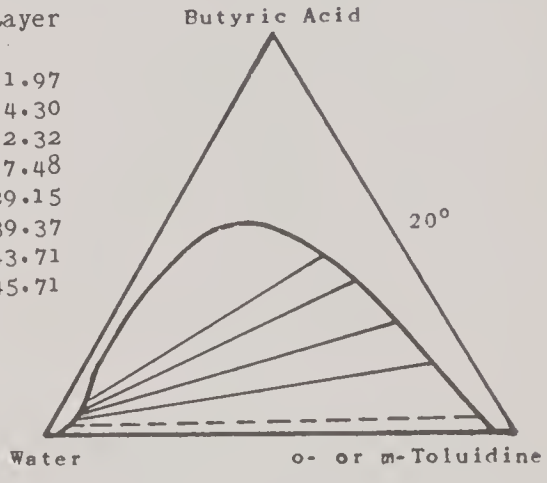
Butyric Acid in:

Aqueous Layer	Aniline Layer
1.05	1.92
2.28	6.67
4.28	15.98
5.31	24.51
6.29	29.93
7.70	38.83
9.05	44.18

Similar data are given at 0° and 40°. Attention was called to the unusual hollow in the curve near the water corner, which was more pronounced in the 0° isotherm but almost disappeared in the 40° isotherm. It seems possible that at very high concentrations of water, there is little aniline butyrate present because of hydrolysis, and that the butyric acid is an excellent homogenizer of water and aniline, requiring perhaps only 30 or 35% at the apex. However, aniline butyrate, which forms in other parts of the diagram, is a poorer homogenizer because of its low affinity for water, so that the apex is above 50% butyric acid. As in most cases of reverse curves there are at least four kinds of molecules in the system. The system has an isopycnic (dashed tie line) connecting compositions with equal densities (position estimated by compiler).

n-BUTYRIC ACID - o.Toluidine, $CH_3C_6H_4NH_2$ (Angelescu and Cristodulo (1940b)).

Gms. per 100 gms. Mixture at 20°			Distribution gms. per 100 gms.	
Water	Butyric Acid	o-Toluidine	Aqueous Layer	Toluidine Layer
98.54	0	1.46	0.67	1.97
91.55	5.32	3.13	1.45	4.30
85.05	13.06	1.89	2.68	12.32
74.24	23.26	2.50	3.45	17.48
62.90	33.27	3.88	4.98	29.15
50.38	43.86	5.76	6.62	39.37
42.37	49.57	8.06	7.36	43.71
30.20	53.76	16.04	7.84	45.71
22.14	49.93	27.93		
18.21	44.23	37.56		
14.82	37.66	47.52		
9.82	25.79	64.39		
4.21	7.45	88.34		
2.28	0	97.72		



cf. Note under Butyric acid-aniline. Similar isotherms at 0° and 40° are presented.

n-BUTYRIC ACID - m-Toluidine, $CH_3C_6H_4NH_2$. Angelescu and Cristodulo (1941-2).

The graph is almost identical with that for o-toluidine. Similar data for 0° and 40° are presented.

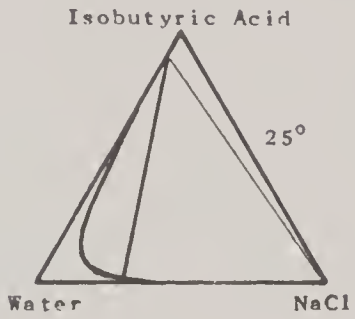
Gms. per 100 gms. Mixture at 20°			Distribution gms. per 100 gms.	
Water	Butyric Acid	o-Toluidine	Aqueous Layer	Toluidine Layer
98.77	-	1.23	0.48	2.48
92.27	4.50	3.23	1.17	3.68
84.25	13.98	1.77	2.06	9.11
73.99	23.66	2.35	3.12	16.65
62.46	34.19	3.35	4.58	27.75
51.02	44.03	4.95	5.16	33.15
40.53	51.62	7.85	6.25	40.29
30.80	55.06	14.14	7.34	46.65
24.33	52.34	23.33		
18.18	42.53	39.29		
13.99	34.88	51.13		
10.46	26.03	63.51		
6.91	15.95	77.14		
3.05	-	96.95		

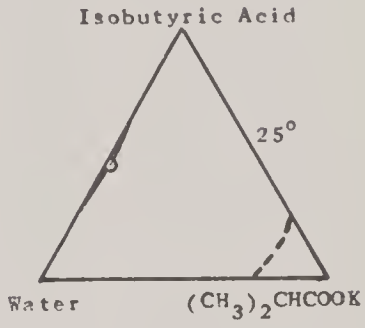
ISOBUTYRIC ACID

$C_4H_8O_2$ - Isobutyric Acid - $(CH_3)_2CHCOOH$.

See CCl_4, $CHCl_3$.

ISOBUTYRIC ACID - NaCl (I 1245); Potassium Isobutyrate (I 701).





These data are slightly inconsistent with the majority of the observations of critical solution temperature of water and isobutyric acid (II 250-1) which are below 25°.

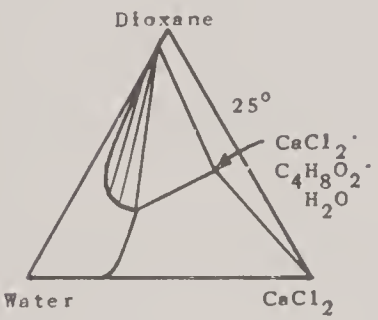
The latter system has a very shallow binodal curve, since 0.37% of potassium isobutyrate suffices to "salt in" isobutyric acid (in contrast to NaCl which "salts it out"). The dashed line (position conjectural) shows equilibrium with solid potassium isobutyrate.

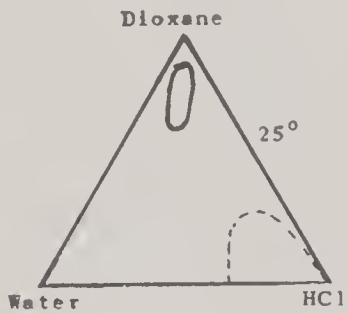
Distribution of isobutyric acid between water and ether (II 252), n- and isoamyl alcohols (II 255), petroleum ether (II 257), nitrobenzene (II 255), benzene (II 252-4) (cf. also Shilov and Lepin, 1922), toluene (II 252-3), xylene (II 252), olive oil (II 257). At least four of these systems, petroleum ether, nitrobenzene, benzene, and toluene are solutropic, that is, have horizontal tie lines. Five of them extend to such high concentrations in the organic layer as to suggest that the apex of the binodal curve was reached; but this is proven only in the case of carbon tetrachloride (illustrated under CCl_4 above).

$C_4H_8O_2$ - DIOXANE - $CH_2CH_2OCH_2CH_2O$ (called also Diethylene Ether II 254, cf. II 259).

DIOXANE - $CaCl_2$, Calcium Chloride. (H. F. Bogardus and C. C. Lynch, J. Phys. Chem. 47, 653, 1943).

Lower Layer			Upper Layer		
Water	Dioxane	$CaCl_2$	Water	Dioxane	$CaCl_2$
39.59	54.0	6.41	1.46	98.54	0
47.0	40.2	12.8	4.02	95.98	0
47.9	32.8	19.3	7.24	92.71	0.05
43.5	27.9	28.6	18.5	80.51	0.99





DIOXANE - HCl, Hydrogen Chloride. (R. A. Robinson and R. C. Selkirk, J. Chem. Soc. 1948, 1460).

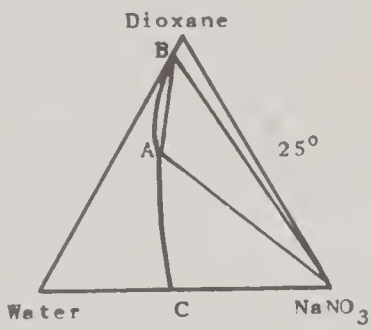
Lower Layer			Upper Layer		
Water	Dioxane	HCl	Water	Dioxane	HCl
8.18	81.5	10.30	0.85	95.6	3.52
14.40	74.3	11.25	1.29	97.5	1.17
18.36	70.7	10.91	2.63	96.5	0.87
22.69	67.7	9.59	4.84	94.7	0.47
21.55	72.7	5.76	7.78	91.7	0.49

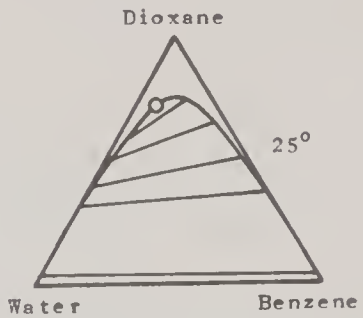
The binodal curve is an almost perfect elipse, with two plait points, and intersecting no side since dioxane is miscible with both water and HCl. Since liquid HCl is miscible with water only to 63.7% (I 571), the graph should include another binodal curve, dashed line (position conjectural) for which data are lacking.

DIOXANE - $NaNO_3$ - Sodium Nitrate. (B. Selikson and J. E. Ricci, J. Am. Chem. Soc. 64, 2475, 1942).

Lower Layer				Upper Layer			
Water	$NaNO_3$	Dioxane	Point	Water	$NaNO_3$	Dioxane	Point
52.13	47.87	-	C	-	-	-	
44.85	34.94	20.21		-	-	-	
36.60	24.69	38.71		-	-	-	
30.03	17.84	52.13	A	6.16	0.44	93.4	B
27.99	12.17	59.84		7.88	0.74	91.4	
				1.90	0.009	98.09	

Densities also are given.





DIOXANE - Benzene. (Berndt and Lynch (1944)).

Gms. per 100 gms. mixture at 25°.

Lower Layer			Upper Layer		
Water	Dioxane	Benzene	Water	Dioxane	Benzene
94.8	5.1	0.1	0.1	5.2	94.7
81.0	18.9	0.1	0.2	22.5	77.3
70.0	29.8	0.2	0.7	38.5	60.8
58.9	40.8	0.3	1.5	53.0	45.5
48.4	50.8	0.8	3.4	66.5	30.1
34.5	62.8	2.7	8.5	74.9	16.6
29.7	66.3	4.0	11.8	74.5	13.7
21.7	70.8	7.5	Plait Point		

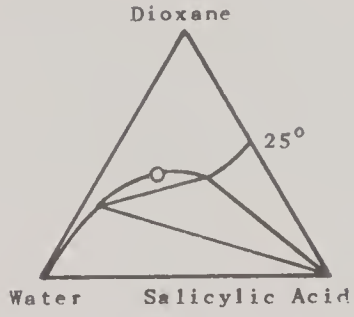
DIOXANE - C_6H_5CHO, Benzaldehyde.

Siggia and Hanna (1949) studied the system and reported that it was similar to that of methanol and chlorobenzene (q.v.) with the apex of the curve at about 62% methanol. No numerical data are given.

TERNARY AQUEOUS SYSTEMS

DIOXANE - $C_7H_6O_3$ - Salicylic Acid o-HOC_6H_4COOH (II 523).

The shape of the binodal curve is speculative since only the extremities are given in the original paper, 62% water, 30% dioxane, 8% salicylic acid, and 28% water, 42% dioxane, 30% salicylic acid, respectively (recalculated to gms. per 100 gms. mixture).
Correction: In the footnote of Herz and Lorentz's table (II 523) read "2.29 gm. equiv. salicylic acid" (instead of dioxane).



$C_4H_8O_3$ - α-Hydroxybutyric Acid, $CH_3CH_2CHOHCOOH$.

Distribution between water and ether or amyl alcohol (II 258, 259).

$C_4H_8O_3$ - β-Hydroxybutyric Acid, $CH_3CHOHCH_2COOH$.

Distribution between water and ether (II 258). The α-formula was inadvertently assigned to both acids.

$C_4H_8O_5$ - Trihydroxybutyric Acid, $CH_2OHCHOHCHOHCOOH$.

(Int. Critical Tables III 426). Distribution between water and olive oil.

C_4H_9Br - n-Butyl Bromide - $C_4H_{11}N$ (II 279).. See diethyl amine.

C_4H_9Br - Isobutyl Bromide. See C_2H_6O, ethanol.

C_4H_9Cl - n-Butyl Chloride - $C_4H_{10}O$, n-Butanol.

Distribution - (Bogin 1924).

$C_4H_9O_2N$ - α Aminobutyric Acid, $CH_3CH_2CHNH_2COOH$.

See $C_4H_{10}O$, n-butanol (II 265, 267)

$C_4H_9O_2N$ - Propyl Carbamate. See note under $C_2H_5O_2N$.

C_4H_{10}, n-Butane. See $C_5H_4O_2$, Furfural.

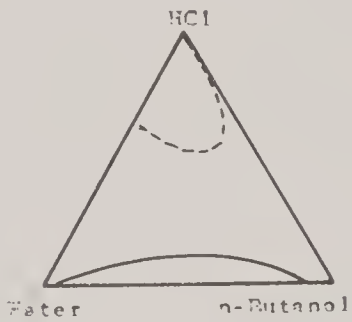
C_4H_{10} - Isobutane, $(CH_3)_3CH$. See $C_5H_4O_2$, Furfural.

McBain and O'Connor (1941) showed enhancement of solubility of isobutane in water by potassium oleate.

n-BUTANOL

$C_4H_{10}O$ - n-Butanol, $CH_3(CH_2)_3OH$. See formic acid (II 29), methanol, acetic acid, glycine (II 125), ethanol, acetone, propionic acid (II 188-9), lactic acid (with acetic acid), α-amino-propionic acid (II 200), glycerol, ethyl acetate, n-butyric acid (II 256), α-amino butyric acid (II 265, 267), n-butyl chloride, 2, 3-butene glycol, diethyl amine (II 278), n-valeric acid (II 302), n-caproic acid (II 440), cyclohexane, n-heptane, gasoline.

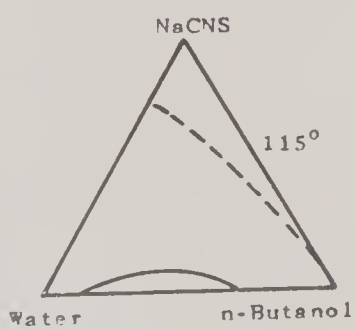
n-BUTANOL - HCl, Hydrogen Chloride (I 574). See note under dioxane-HCl.

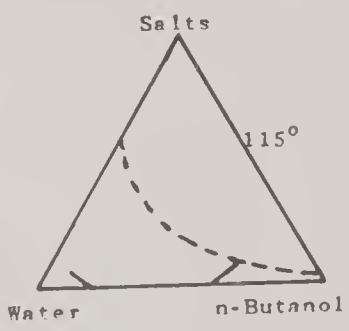


n-BUTANOL - HNO_3 (I 583, ref.), H_2SO_4 (Int. Crit. Tables III 400).

n-BUTANOL - KCl (I 779). Distribution.

n-BUTANOL - NaCNS. (Reber, McNabb, and Lucasse, 1942).





n-BUTANOL - NaBr, NaCl, NaI, $NaNO_3$, Na_2SO_4. (Reber, McNabb, and Lucasse, 1942).

The effects of the salts upon the miscibilities of water and n-butanol at 90 to 135° was observed. Sodium thiocyanate increases the miscibility, but the others decrease it. The points in the binary system water-n-butanol are at 13.2% and 57.1% n-butanol. The dashed lines are added by the compiler to show schematically the approximate solubilities of the solid salts.

n-BUTANOL

Critical solution temperatures are as follows:

Salt	Molality	C.S.T.
NaCl	0.08	136.75
NaBr	0.1	135.40
NaI	0.3	135.30
$NaNO_3$	0.12	134.35
Na_2SO_4	0.008	129.20
NaCNS	1.1	112.50
Lower C.S.T.		15.90
-	0	124.4

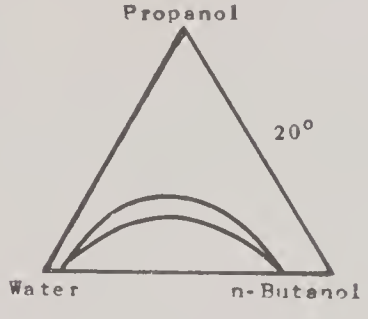
n-BUTANOL - n-Propanol and Isopropanol. (Bogin, 1924).

No numerical data were given, but curves for both propyl alcohols were plotted on the same graph from which the following data in gms. per 100 gms. mixture at 20° were recalculated:

Water	n-Propanol	n-Butanol	Water	Isopropanol	n-Butanol
92.7	0	7.3[a]	92.7	0	7.3[a]
73.5	14.5	12	73.5	17.3	9.2
65	17.5	17.5			
48.1	21.8	30.1	57	26	17
39.5	23	37.5	38.5	30.8	30.8
30	17.5	52.5	31	27.6	41
20	0	80[a]	24	19	57
			20	0	80[a]

(a) Taken from II 266-7.

In the compiler's opinion a typographical error occurs in the legend in Bogin's paper interchanging the two propyl alcohols since (a) in all other cases isopropanol is a better homogenizer for water and organic liquid than is n-propanol; (b) his own observations agree closely with Bogin's data provided isopropanol is assigned the lower curve and n-propanol the upper one. (c) International Critical Tables compiled the data on that basis.



n-BUTANOL - α-Amino-n-Valeric Acid, $CH_3CH_2CH_2CHNH_2COOH$ (II 309).

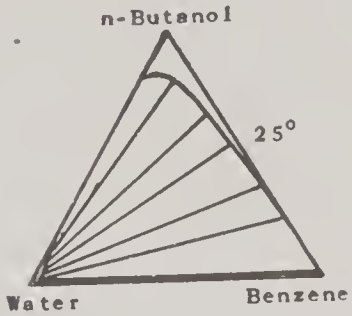
Correction: In the title of the table of England, Albert, and Cohn instead of "Butyric Acid" read "Butyl Alcohol" or "Butanol".

n-BUTANOL - α-Amino-isovaleric Acid (Valine), $(CH_3)_2CHCHNH_2COOH$ (II 311).

n-BUTANOL - C_6H_6, Benzene (II 267).

(Washburn and Strandskov (1944)). Gms. per 100 gms. solution at 25°.

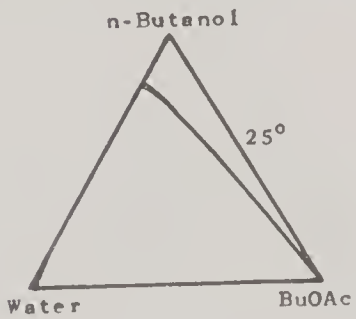
Lower Layer			Upper Layer		
Water	n-Butanol	Benzene	Water	n-Butanol	Benzene
97.9	1.9	0.2	0	2.4	97.6
95.9	3.8	0.3	1.4	25.2	73.4
95.1	4.5	0.4	3.4	39.7	56.9
94.4	5.3	0.3	6.1	55.6	38.3
93.7	6.0	0.3	8.9	65.7	25.4
93.1	6.7	0.2	16.3	77.9	5.8



Similar data are given at 35°. Data for this system are presented also by Ormandy, Pond, and Davies (1934) (plotted under benzene), and by Bogin (1924).

n-BUTANOL - $C_6H_{12}O_2$, n-Butyl Acetate $CH_3(CH_2)_3OCOCH_3$ (BuOAc)

(Brunjes and Furnas, 1936). Gms. per 100 gms. mixture at 25°.



Lower Layer (BuOAc negligible)		Upper Layer		
Water	Butanol	Water	Butanol	BuOAc
99.12	0.88[a]	0.42	0.0	99.58
		0.63	9.24	90.12
		3.71[b]	22.35	73.92
		8.00	39.20	52.80
		11.86	55.26	32.86
		15.21	70.98	13.80
92.67	7.32	19.75	80.25	0.00

(a) Average value.
(b) The original lists 33.71, a typographical error.

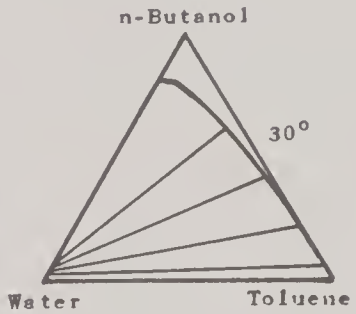
n-BUTANOL - Norleucine and Leucine, α-Amino-n- and isocaproic acids (II 456).

Distribution.

n-BUTANOL - C_7H_8, Toluene, (Fuoss, 1943). Gms. per 100 gms. mixture at 30°.

Lower Layer (Toluene negligible)		Upper Layer		
Water	n-Butanol	Water	n-Butanol	Toluene
99.15	0.85	0.0	1	99
97.45	2.55	0.2	5	94.8
96.25	3.75	1.2	20	78.8
95.45	4.55	3.5	40	56.5
94.60	5.40	7.8	60	32.2
92.90	7.10	20.6	79.4	0

Data for this system are presented also by Ormandy, Pond, and Davies (1934).



n-BUTANOL - n-Butyl Ether, $(CH_3CH_2CH_2CH_2)_2O$.

(G. Lazzari, Ann. chim. applicata 38, 287 (1948); Chem. Abstr. 43, 5273).

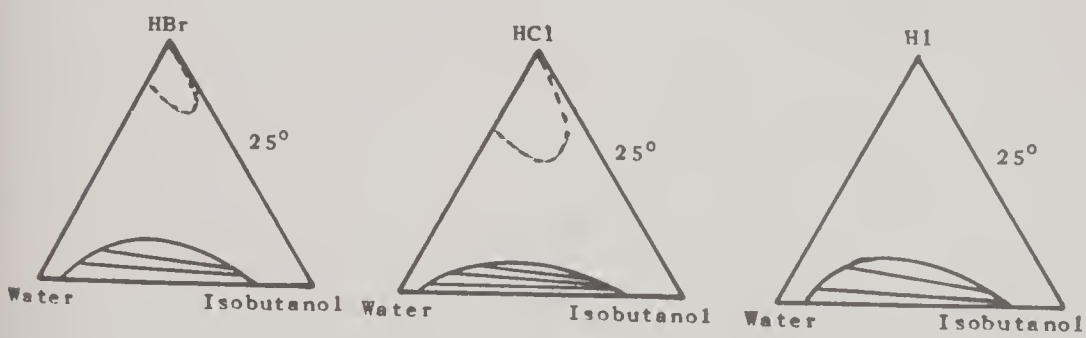
$C_4H_{10}O$, sec-Butanol, $CH_3CH_2CHOHCH_3$.

See formic acid (II 29), acetic acid (II 106), propionic acid (II 189), butyric acid (II 256), ethyl acetate, tri-methylethylene, n-valeric acid (II 302), benzene, cyclohexane, n-caproic acid (II 440), toluene, n-heptane, and gasoline.

$C_4H_{10}O$ - Isobutanol - $(CH_3)_2CHCH_2OH$.

See hydrogen peroxide, carbon disulfide, methyl iodide, methanol, tetrachloroethane, chloroacetic acid, acetic acid, ethanol (II 136, 268), malonic acid (II 168), acetone, propionic acid (II 188), lactic acid (with acetic acid), n-butyric acid (II 256), ethyl acetate, diethyl amine (II 278), isovaleric acid (II 305), cyclohexane, benzoic acid (II 512), toluene, n-heptane, gasoline.

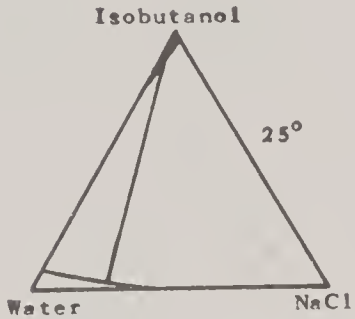
ISOBUTANOL - HBr (I 568) HCl (I 574) HI (I 580)



ISOBUTANOL

Since liquid HCl is miscible with water only to 63.7% (I 571), the graph should include another binodal curve, dashed line (position conjectural) for which data are lacking. The solubility of HBr in water is 82%, giving a similar curve. The solubility of HI is unknown. Correction: on p. I 580, the first item under $C_4H_{10}O$ should be 83.9 instead of 88.9.

ISOBUTANOL - NaCl, Sodium Chloride. (Fritzsche and Stockton, 1946).



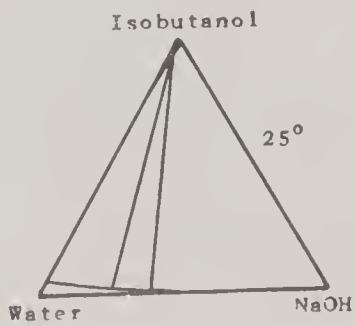
Composition in gms. per 100 gms. solution.

Water	Isobutanol	NaCl
74.0	0.0	26.0
76.8	1.2	22.0[a]
85.6	2.6	11.8
91.1	5.6	3.3
91.9	6.6	1.5
14.7	85.1	0.2
3.1	96.5	0.4[a]

(a) These two are triple points, i.e. two liquids in equilibrium with sodium chloride crystals.

ISOBUTANOL - NaOH, Sodium Hydroxide. (Fritzsche and Stockton, 1946).

(Cf. also Int. Crit. Tables III 422).



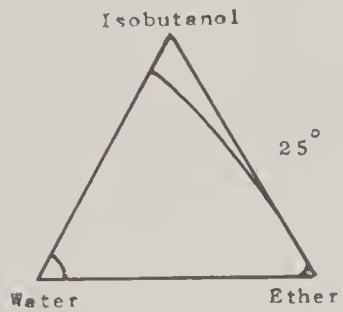
Water	Isobutanol	NaOH
50.0	0.0	50.0
64.9	0.1	35.0[a]
74.8	0.4	24.8[a]
84.9	0.9	14.5
90.2	3.1	6.7
92.5	6.2	1.3

(a) The conjugate solutions (upper layers) in both cases contain 0.3% NaOH and 0.2% water.

ISOBUTANOL - $C_4H_{10}O$, Ether. (Fritzsche and Stockton, 1946).

Compostions in gms. per 100 gms. Solution

Lower Layer			Upper Layer		
Water	Isobutanol	Ether	Water	Isobutanol	Ether
94.0	0.0	6.0	1.3	0.0	98.7
93.5	2.1	4.4			
91.4	6.0	2.6			
92.4	7.6	0.0	16.4	83.6	0.0[a]
			0.1	1.5	98.4
			1.1	14.7	84.2
			1.9	29.4	68.7
			5.1	42.0	52.9
			8.0	52.0	40.0
			11.3	59.9	28.8
			12.9	67.9	19.2
			14.1	76.9	9.0



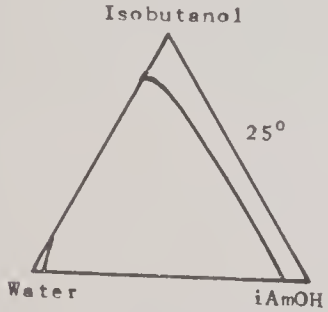
(a) This point is listed out of order to be opposite its conjugate liquid phase. At the lower end of the curve is a curious sharp bending away from the ether corner. The curve for the aqueous layer is sharply concave.

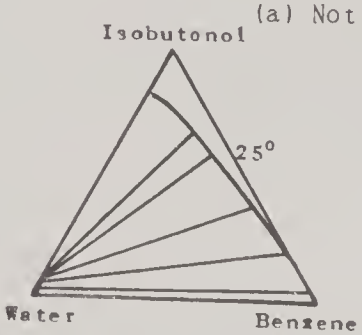
ISOBUTANOL - $C_5H_{12}O$ - Isoamyl Alcohol (Brun, 1925).

Compositions in gms. per 100 gms. Solution

Lower Layer			Upper Layer		
Water	Isobutanol	iAmOH	Water	Isobutanol	iAmOH
88.0	12.0	0	18	82	0
92.25	5.81	1.94	15.5	76.55	7.95[a]
			12.0	66.42	21.08
96.05	0.0	3.95	9.0	0.0	91.0

(a) Not a tie line.





Distribution of 148 substances between isobutanol and water. (R. Collander, Acta Chem. Scand. 4, 1085-98, 1950) in English.

ISOBUTANOL - C_6H_6 - Benzene (Alberty and Washburn, 1945).

Compositions in gms. per 100 gms. Solution at 25°

Lower Layer			Upper Layer		
Water	Isobutanol	Benzene	Water	Isobutanol	Benzene
99.85	0.00	0.15	0.07	0.00	99.93
97.39	2.33	0.28	0.19	3.61	96.20
95.44	4.30	0.26	1.06	19.87	79.07
94.59	5.23	0.18	3.34	39.57	57.09
93.83	6.04	0.13	6.54	59.48	33.98
93.46	6.43	0.11	8.86	67.68	23.46
91.99	8.01	0.00	17.01	82.99	0.00

Holmes (1918) presented data from which the point 2.25% water, 31.7% isobutanol, and 66.05% benzene is calculated. Ormandy, Pond, and Davies (1934) gave numerous data which are plotted under benzene below.

ISOBUTANOL - $C_{20}H_{20}ClN_3$ and $C_{20}H_{24}ClN_3$. Fuchsin and New Fuchsin.

(Int. Critical Tables III 432) Distribution.

ISOBUTANOL - Olive Oil (Int. Critical Tables III 426).

ISOBUTANOL - Cottonseed Oil (II 270).

Distribution of 12 dyes between water and isobutanol (II 830).

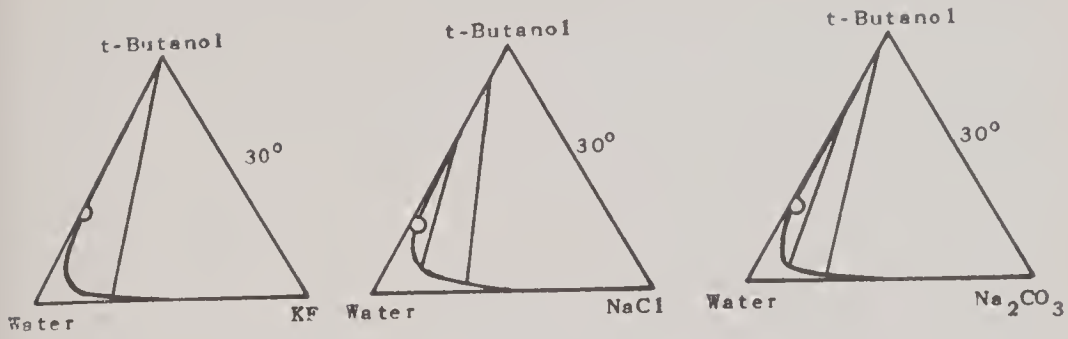
$C_4H_{10}O$ - tert-Butanol - $(CH_3)_3COH$.

See sodium acetate (I 1169), ethyl acetate, cyclohexane, toluene, n-heptane, gasoline.

tert-BUTANOL - Salts (salting out).

References in Seidell I. $BaCl_2$ (161), $CdSO_4$ (385), KBr (692, 695), KCNS (725), K_2CO_3 (740), KCl (778), $K_3Fe(CN)_6$ (723) (in the title of the table of Ginnings, Herring, and Webb read "Ferricyanide" instead of "Ferrocyanide"), KF (808), KI (821), $LiNO_3$ (927), $MgSO_4$ (994), NH_4Cl (1090), NH_4NO_3 (1113), $(NH_4)_2HPO_4$ (1119), $(NH_4)_2SO_4$ (1131), $NaAl(SO_4)_2$ (1315), NaBr (1162), $NaOOCCH_3$ (1169), Na_2CO_3 (1212-3), NaCl (1244), $NaNO_3$ (1282), Na_2SO_4 (1314), $Na_2S_2O_3$ (1315), $SrBr_2$ (1497), $SrCl_2$ (1511), $ZnSO_4$ (1596).

tert-BUTANOL



Data for the KBr, K_2CO_3, KCl, KI, NH_4Cl, $(NH_4)_2SO_4$, $NaNO_3$, and Na_2SO_4 systems also are sufficient to plot graphs, but they would not be much different from those shown.

tert-BUTANOL - Salts.

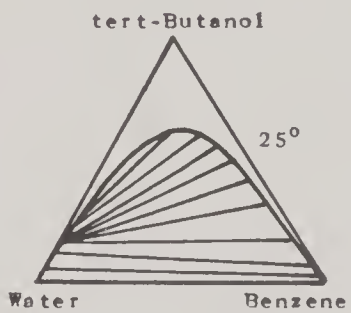
Plait points are given for systems with four other salts by Ginnings, Herring, and Webb, (J. Am. Chem. Soc., 55, 75, 1933).

Gms. per 100 gms. Solution			Formula	Name
Water	tert-Butanol	Salt		
64.8	31.4	3.8	$(NaOOCCHOH)_2$	Sodium Tartrate
64.9	31.1	4.0	$NaKC_4H_4O_6$	Rochelle Salt
65.8	31.6	2.6	$NaHCO_3$	Sodium Bicarbonate
64.4	29.5	6.1	$NaHSO_4$	Sodium Bisulfate

tert-BUTANOL - C_6H_6 - Benzene (Simonson and Washburn, 1946).

Gms. per 100 gms. Solution at 25°

Lower Layer		Upper Layer	
Butanol	Benzene	Butanol	Benzene
1.62	0.17	0.65	99.22
9.40	.27	6.70	92.94
13.17	.33	17.98	80.79
15.08	.38	33.54	66.13
16.36	.40	40.76	53.13
17.44	.43	48.61	41.67
18.58	.47	54.97	30.18
21.23	.60	57.93	18.97
25.26	1.08	55.37	11.72
28.63	1.64	51.78	8.88



The system is solutropic with a horizontal tie line at about 11% tert-Butanol.

tert-BUTANOL

Ormandy, Pond, and Davies(1934) presented additional data which are plotted under benzene.

tert-BUTANOL - $C_{10}H_8$, Naphthalene. (Timmermans, 1907).

tert-BUTANOL - Olive Oil (II 270).

$C_4H_{10}O$, Ether, $(C_2H_5)_2O$ Salts, Distribution

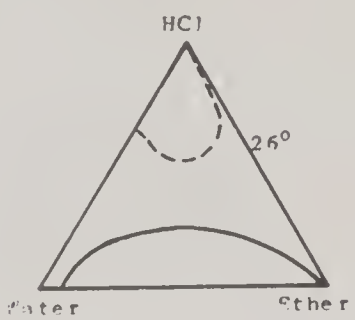
$Al_2(SO_4)_3$	II 275	LiCl	II 275	Na_2MoO_4	II 275
$AuCl_3$	I 116	$MgBr_2$	(4)	NaOH	II 276
CdI_2	I 369-70	MgI_2	I 973	Na_3PO_4	II 275
$Cr(CNS)_3$	I 442	NH_4CNS	I 1064	Na_2SO_4	II 275-6
$CuCl_2$	I 488	$(NH_4)_2C_2O_4$	II 275	Na_2WO_4	II 275
$FeCl_3$	I 530, II 275	NH_4NO_3	II 275	$PdCl_2$	I 1418
$Fe(CNS)_3$	I 522	Na_3AsO_4	II 275	$PtCl_4$	I 1425
$FeSO_4$	II 275	NaBr	II 275	$SbCl_3$	I 1480
$Hg(CN)_2$	II 275	Na_2CO_3	(2)	$SbCl_5$	I 1480
$HgCl_2$	I 632-3	NaCl	II 275-6 (5)	$TeCl_4$	(3)
$IrCl_4$	I 680	Na_2CrO_4	II 275	UN_2O_8	I 1566, (1)
KCl	II 275	$Na_2Cr_2O_7$	II 275	$ZnCl_2$	I 1566
KI	I 822	NaF	II 275	ZnI_2	I 1586
KNO_3	II 275	NaI	II 275		

Thirteen sodium salts of organic acids II 275-6.

(1) M. Backelet, E. Cheylan, and L. Bris., J. chim. phys. 47, 62 (1950).
(2) Euler (1904); (3) Mylius, Z. appl. Chem., 70, 203 (1911).
(4) H. A. Rowley and M. H. Bartz, Proc. Iowa Acad. Sci. 48, 276 (1941).
(5) E. L. Smith (1932).

ETHER - HCl, Hydrogen Chloride (II 273-4).

Composition recalculated to gms. per 100 gms. solution at 26°.



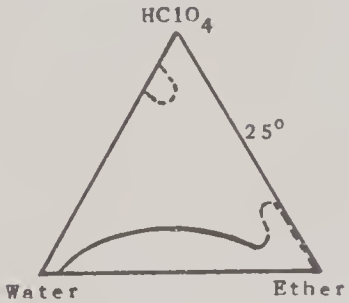
Water	HCl	Ether
91.1	2.8	6.1
80.6	11.6	7.8
67.9	17.1	15.0
41.7	19.3	39.0
33.8	21.2	45.0

The position of the upper binodal curve, except its extremities, is speculative. See notes under dioxane-HCl and isobutanol -HCl.

ETHER - $HClO_4$ - Perchloric Acid (II 274).

Compositions recalculated to gms. per 100 gms. mixture.

Water	$HClO_4$	Ether
54.5	15.9	29.6
34.3	15.2	50.5
27.4	14.1	58.5
19.7	12.6	67.7
16.2	11.9	71.9
13.6	11.2	75.2
11.6	10.5	77.9
9.7	12.2	78.1
7.1	17.5	75.4



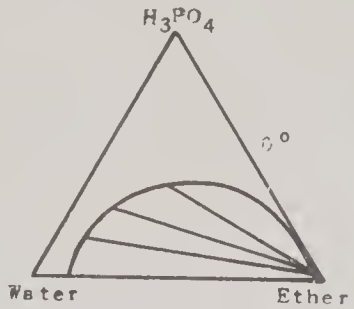
The dotted portions of the graph except their extremities are speculative. The upper curve shows equilibrium with solid $HClO_4 \cdot H_2O$. M. P. 50° (Cf I 578). The S portion of the binodal curve is due to a fourth type of molecule in solution, probably the same hydrate. No data for tie lines are available.

ETHER - HNO_3, Nitric Acid (I 583).

Distribution.

ETHER - H_2O_2, Hydrogen Peroxide (I 590).

Distribution.

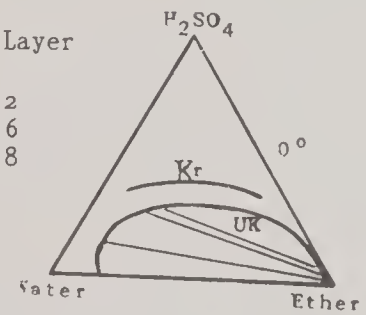


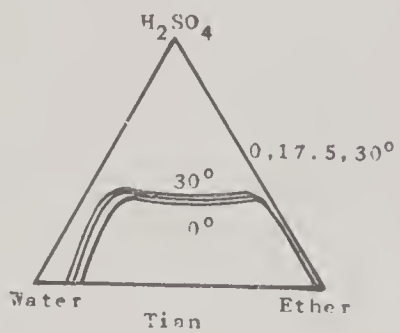
ETHER - H_3PO_4, Phosphoric Acid (II 273-4).

Tie lines at 0° (Ust-Kachkintsev and Klebnikov, 1939).

Gms. H_3PO_4 per 100 gms.

Lower Layer	Upper Layer
14.4	1.2
28.1	1.6
36.5	1.8





Tian

ETHER - H_2SO_4. Sulfuric Acid (II 274-6)

ETHER - H_2SO_4, Sulfuric Acid (Cont.).

The data of Kreman (Kr) and those of Ust-Kachkinstev and Klebnikov (U. K.) are very inconsistent. The latter give data for tie lines in gms. H_2SO_4 per 100 gms. at 0°.

Lower Layer	Upper Layer
12.2	0.5
25.3	3.9
30.5	4.3

(A. Tian, 1946).

No numerical data are presented. The "saddle curves" are inconsistent with the other data; and for a ternary system are "impossible", especially with a concavity near the plait point (see preface). Yet the curves have been confirmed experimentally by the compiler. They probably result from the rapid and reversible formation of half ester, ethyl sulfuric acid, producing a quaternary system. It is not clear how the other investigators avoided the reaction. Pound (J. Chem. Soc. 121, 945, 1922) studied a portion of the system and concluded that ester formation caused no interference. Perhaps he referred to the formation of ethyl sulfate.

ETHER - I_2, Iodine (V. I. Nesterova and N. H. Petin, J. Gen. Chem. (U.S.S.R.) 1,272, 1931; Chem. Abstr. 26, 3168).

Distribution.

ETHER - NH_3 - Ammonia. (Int. Critical Tables II 420).

Distribution.

ETHER - Organic Acids.

Distribution between water and ether (page numbers in Seidell II).

Acetic[a,b]	102, 110, 114	Cyanoacetic	164
Anthranilic	540	Dibromopropionic	165
Azelaic	643	Dibromosuccinic	219
Benzilic	749	Dichloroacetic	78
Benzoic	510, 512, 515	Dimethylmalonic[a]	293
Bromoacetic	86	2,4-Dinitrobenzoic[a]	472
α- Bromopropionic	170	3,5 Dinitrobenzoic	472
Bromosuccinic[a]	219	Formic[c]	27, 28
n-Butyric	251,256	Fumaric	216
Camphoric	681	Gallic (3,4,5-Trihydroxy-benzoic	533
Caproic	438, 440	Gentisic (2,5-Dihydroxy-benzoic	531
Chloroacetic	88, 89	Glutaric	293
o-Chlorobenzoic	476	Glycollic	117-8
Citric	428		
Crotonic	221		

ORGANIC ACIDS - (Cont.).

Hippuric	633	Phenylacetic	582
Homophthalic ICT[d] 431		o-Phthalic	574
p-Hydroxybenzoic	530	m-Phthalic	574
α and β-Hydroxybutyric	258-9	Picric	330
o-Iodobenzoic	478	Pimelic	561
β-Iodopropionic	172	Propionic[c]	188
Isobutyric	252	Pyruvic	166
Isovaleric	303	Resorcylic (2,4-Dihydroxy-benzoic)	531
Itaconic	291	Salicylic	524
Keto γ-phenyl adipic ICT[d] 432		Sebacic	683
Lactic[c]	194	Suberic	618
Levulinic	292	Succinic[a]	229, 276
Maleic	216	Tartaric	235-6
Malic	232	Thioacetic	118
Malonic	167-8	Trichloroacetic[a]	68
Mandelic	594	Trinitrobenzoic	469
m-Nitrobenzoic	486	n-Valeric	301-2
Oxalic	83, 84		

(a) Solutropic (with a horizontal tie line).
(b) Graph given in this volume under acetic acid.
(c) Data given in this volume under the acid.
(d) Int. Critical Tables III.

Distribution of Organic Compounds (except Acids and Salts) between Water and Ether. (Page numbers in Seidell II).

Acetanilide	605	Heptyl Amine	569
Acetone[b]		Hydroquinone	400
Aniline	416	Isoamyl Amine	318
Aspirin	630	Isobutanol[b]	
Benzyl Amine	554	Mannitol	275
Benzyl Ethyl Amine	642	Methanol[b]	46
Benzyl Methyl Amine	616	Methyl Amine	64
n-Butyl Amine[a]	280	Methyl piperidine	452
Caffeine ICT[d] 431		Novocaine	729
Chloral Hydrate	93	Pantocaine	729
Chloroform[b]	14	Piperidine	308
Codiene ICT[d] 432		n-Propanol[c]	
Coniine	621	Quinine	803
m-Cresol	549	Resorcinol	396
Cyanoform[c]		Saccharine	478
Diethyl Amine	279	Succinonitrile[b]	
Diethyl Tartrate	619	Triethyl Amine ICT[d] 415	
Dimethyl Amine	160	Trimethyl Amine	211
Di-n-propyl Amine	465	Vanillin	589
Ethanol[a,b]	103, 153	Vinyl Pyrollidone[b]	
Ethyl Amine	161	Aconitine ICT[d] 433	
Formaldehyde	25	200 Organic Compounds[e]	

(a) Solutrope
(b) Graph given in this volume under solute.
(c) Data given in this volume under solute.
(d) Int. Critical Tables III.
(e) Collander, Act Chim. Scand., 2, 717 (1949).

TERNARY AQUEOUS SYSTEMS

2,3 BUTENE GLYCOL

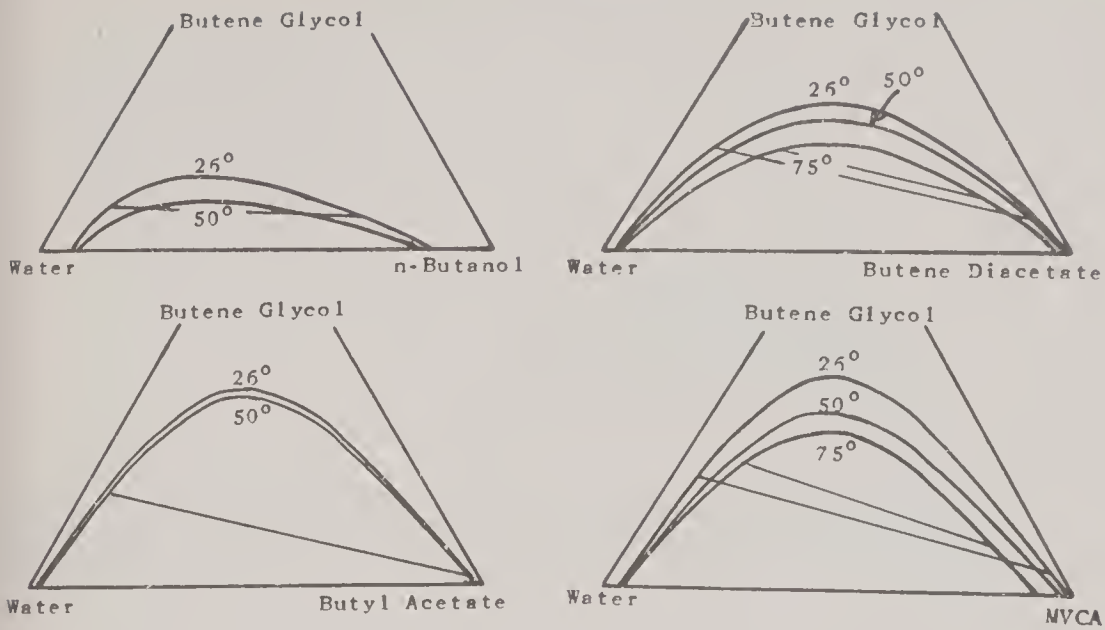
$C_4H_{10}O_2$. 2,3-Butene Glycol $CH_3CHOHCHOHCH_3$.

Systems with four solvents - n-Butanol, $C_4H_{10}O$; Butyl Acetate $CH_3(CH_2)_3OCOCH_3$; Butene Diacetate. $CH_3CH(OCOCH_3)CH(OCOCH_3)CH_3$; Methyl Vinyl Carbinol Acetate, $CH_2{:}CHCH(CH_3)OCOCH_3$, MVCD. (D. E. Othmer, W. S. Bergen, N. Schlecter, and D. F. Bruins, Ind. Eng. Chem. 37, 890, 1945).

Compositions in gms. per 100 gms. of each layer.

Aqueous Layer			Temp.	Solvent Layer		
Water	Glycol	Solvent		Water	Glycol	Solvent
			n-Butanol			
93.5	0	6.5	26	19.8	0	80.2
80.2	11.7	8.1		30.3	8.7	61.0
57.5	14.5	28.0				
93.9	0	6.1	50	21.0	0	79.0
72.5	11.0	16.5		38.5	10.0	51.5
56.7	11.75	31.4				
			Butyl Acetate			
89.4	9.5	1.05	26			
74.6	24	1.6		1.8	2.7	96.0
32.9	49.8	17.2				
99.3	0.0	0.69	50	3.19	0.0	96.8
82.6	16.3	1.1		2.9	0.6	96.5
63.5	34.1	2.4		3.0	2.0	95.0
36.6	48.3	15.15				
			Butene Diacetate			
96.3	0	3.62	26	3.7	0	96.3
61.0	30.7	8.3		4.8	4.6	90.6
32.4	37.1	30.4				
97.2	0	2.87	50	3.4	0	96.6
52.6	33.1	14.2				
96.4	0	3.7	75	4.1	0	95.9
45.0	26.8	28.2		18.2	16.8	65.0
			MVCA			
98.68	0	1.32	26	1.0	0	99
81.8	16	2.2		1.9	3.0	95.1
65.7	31.3	3.0		2.0	4.0	94.0
21.6	54.4	24.1				
99.2	0	0.8	50	1.1	0	98.9
82.7	14.3	3.0		1.8	3.2	95.0
66.3	29.2	4.5		2.0	4.4	93.7
33.5	44.0	22.6				
98.0	0.0	2.0	75	1.9	0	98.1
82.0	14.8	3.2		2.0	5.1	93.8[a]
59.0	33.8	7.2		3.2	10.3	86.5
48.2	39.5	12.4				

(a) Adds to 100.9



$C_4H_{10}O_3Si$ - Ethyl Silicate $(C_2H_5)_2SiO_3$. See Ethanol.

$C_4H_{11}N$ - n-Butyl Amine, $C_4H_9NH_2$ (II 280).

Distribution between water and ether or xylene.

$C_4H_{11}N$ - Isobutyl Amine, $(CH_3)_2CHCH_2NH_2$ (II 281).

Distribution between water and xylene.

$C_4H_{11}N$ - Diethyl Amine, $(C_2H_5)_2NH$ (II 279-80).

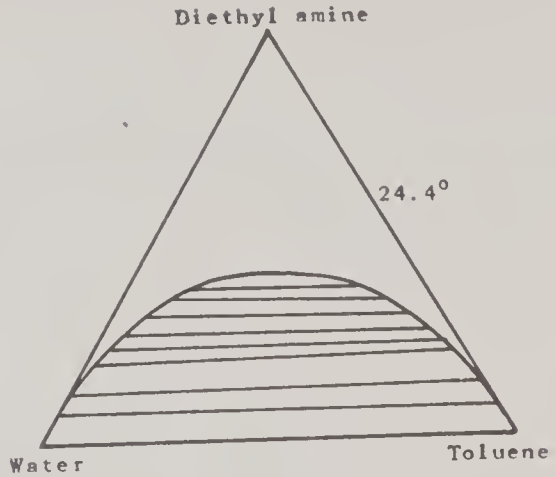
Distribution between water and twenty liquids.

DIETHYL AMINE - Toluene, $C_6H_5CH_3$ (II 280).

(W. E. Wehn and N. W. Franke, Ind. Eng. Chem. 41, 2853, 1949).

Gms. per 100 gms. solution at 24.4°.

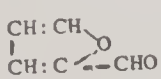
Lower Layer			Upper Layer		
Water	Et_2NH	Toluene	Water	Et_2NH	Toluene
98.3	1.7	0	0	1.2	98.8
93.1	6.8	0.1	0.1	5.6	94.3
86.7	12.8	0.5	0.5	12.1	87.4
81.7	17.5	0.8	1.6	18.1	80.3
77.5	21.2	1.3	2.7	21.9	75.5 (av.)
71.9	25.9	2.3	4.3	26.2	69.5 (av.)
64.7	31.0	4.3	6.9	30.3	62.8
54.1	36.4	9.5	10.9	34.2	54.9
–	–	–	20.0	38.0	42.0
50.0	37.3	12.7	–	–	–
–	–	–	30.0	39.3	30.7
40.0	38.9	21.1	–	–	–



All of the tie lines are nearly horizontal and the slight slope is reversed twice, making the system a "double solutrope". This is apparently the only authentic such case published.

Distribution of Diethyl Amine between Water and Toluene (V. S. Morello and R. B. Beckman, Ind. Eng. Chem., 42, 1081, 1950). Cw/Ct in gm. moles per liter.

Temperature	Cw			
	0	0.1	0.3	0.4
20	2.1	1.98	1.85	1.79
26	1.65	1.50	1.39	1.35
32	1.32	1.18	1.09	1.08
38	1.05	0.91	0.89	0.87
44	0.83	0.74	0.71	0.70
50	0.67	0.60	0.58	
58	0.54	0.47	0.45	

$C_5H_4O_2$ - Furfural 

See acetaldehyde, acetone, lactic acid (under acetic acid), ethyl acetate.

FURFURAL - $C_2H_6O_2$ - Ethylene Glycol.

(J. B. Conway and J. J. Norton, Ind. Eng. Chem., 43, 1433, 1951). Compositions in gms. per 100 gms. solution at 25°.

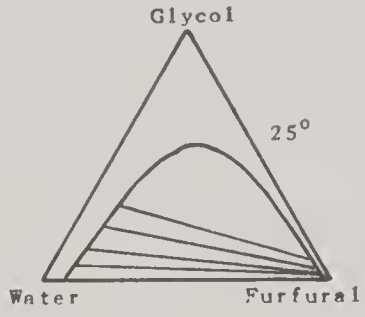
Water	Glycol	Furfural	Water	Glycol	Furfural
92.1	0.0	7.9	18.91	52.9	28.19
80.9	11.21	7.96	11.9	47.5	40.6
72.2	19.15	8.71	8.49	36.2	55.4
62.2	28.1	9.18	7.17	29.74	63.1
57.6	32.2	10.2	4.13	11.45	84.4
41.6	46.3	12.1	5.22	0.0	94.78
29.4	50.6	20.1			

TERNARY AQUEOUS SYSTEMS

FURFURAL

Tie lines. Wt. % Glycol in layers.

Aqueous	Furfural
7.3	2.3
14.3	4.8
21.9	6.1
28.8	7.7



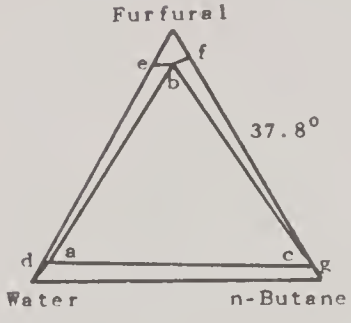
FURFURAL - C_4 Hydrocarbons.

C. Holloway, Jr. and S. H. Thurber, (Ind. Eng. Chem., 36, 980, 1944), reported cloud points for mixtures of 96% furfural and 4% water with varying percentages (up to 34%) of n-butane, isobutane, and 1-butene. At the same temperatures about three times as much olefin is tolerated as paraffin.

FURFURAL - C_4H_{10}, n-Butane.

(J. Griswold, M. E. Klecka, and R. V. West, Jr., Chem. Eng. Progress 44, 839, 1948).

The system gives three liquid layers. It was studied at 37.8°, 51.7°, and at 93.3°.



Compositions at points in gms. per 100 gms. mixture at

	37.8°			93.3°		
Point	Water	Furfural	Butane	Water	Furfural	Butane
a	91.30	8.30	0.4	83.93	15.67	0.4
b	3.59	91.75	4.66	5.61	86.66	7.73
c	0.38	6.84	92.78	0.49	16.38	83.13
d*	90.7	9.3	0	87.7	12.3	0
e*	6.5	93.5	0	14.3	85.7	0
f	0	92.97	7.03	0	83.93	16.07
g	0	8.28	91.72	0	30.0	70.0

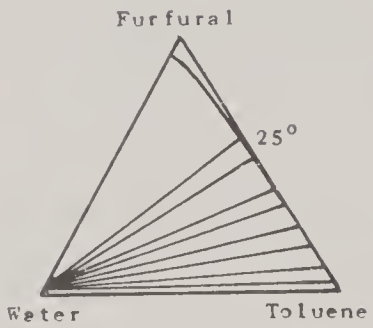
*Interpolated from data of II 281.

It is noted that at all temperatures studied, two of the quadrilateral areas abed and bcgf, converge outward, i.e., de<ab and fg<bc. In the compiler's opinion this condition is typical for systems of three liquid phases, and the succinonitrile-ether system, q.v., is exceptional.

FURFURAL - C_7H_8, Toluene.

(O. S. Knight, Trans. Am. Inst. Chem. Engrs., 39, 439, 1943).

Gms. furfural per 100 gms. of the layers at 25°.

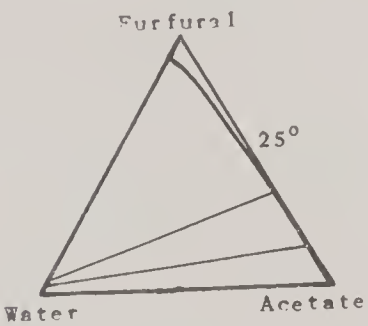


Aqueous	Toluene
0.97	5.5
1.67	10.2
2.5	19.3
3.2	26.3
3.8	35.0
4.4	40.5
4.7	52.2
5.0	60.8
8.5[a]	94.7[a]

(a) Mutual solubilities of furfural and water (II 281).

"Furfural was shown not to be a blending agent for toluene and water." This is due to the incomplete miscibility of water and furfural. Concentrations of water in the toluene phase were undetermined.

FURFURAL - $C_7H_{14}O_2$, Isoamyl Acetate (II 282).



CORRECTION: The lower part of the table should read: "The percentage of furfural in conjugate layers fixing tie lines were:

Layer I	2.0	4.2
Layer II	16.0	36.0"

Layer II begins with the item 94.7% furfural in the upper part of the table.

In column 5 read 78.7 instead of 38.7

FURFURAL - Sodium Oleate (II 281).

C_5H_5N - Pyridine. CH:CHCH:CHCH:N. See CCl_4, CS_2, $CHCl_3$.

Plait points for salts, K_2CO_3, KCl, KF, $MgSO_4$, $(NH_4)_2SO_4$, Na_2CO_3, NaCl, $NaNO_3$, Na_2SO_4, $Na_2S_2O_3$ are given by Ginnings, Webb, and Hinohara (1933) and effects on critical solution temperature of $CaCl_2$, KBr, LiCl, $MgSO_4$, NH_4NO_3, $NaClO_3$ are given by Timmermans (1907).

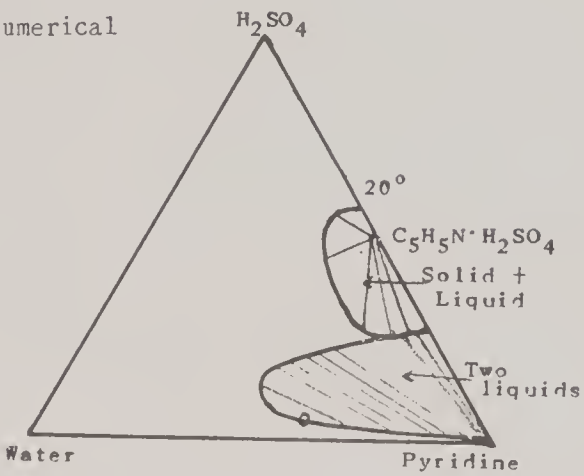
TERNARY AQUEOUS SYSTEMS

PYRIDINE

PYRIDINE - H_2SO_4 - Sulfuric Acid.

(F. H. Peakin, J. Soc. Chem. Ind. 59, 561, 1940).

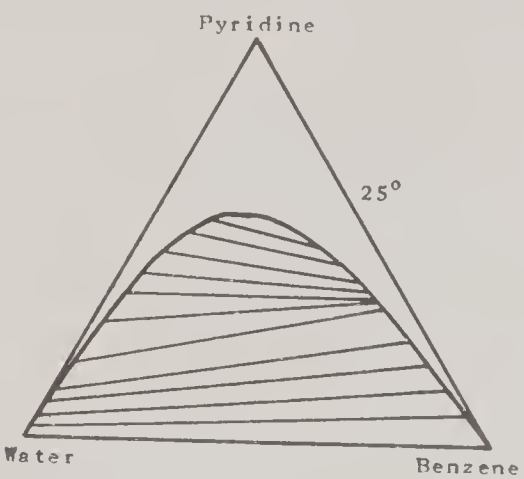
A graph was shown but no numerical data presented.



PYRIDINE - C_6H_6 Benzene (II 288-9).

(J. C. Smith, J. Phys. Chem. 46, 376, 1942).

This system is of interest because it is one of the earliest to be found with such pronounced solutropic effect (reversal in slope of tie lines).



Gms. per 100 gms. Solution at 25°			Tie lines, % Pyridine in	
Water	Pyridine	Benzene	Aqueous Layer	Benzene Layer
95.8	3.9	0.3	2.5	7.5
72.1	26.7	1.2	5.2	13.6
52.3	43.4	4.3	8.0	18.0
33.7	54.8	11.5	11.2	23.9
25.9	56.3	17.8	18.4	30.7
12.3	51.2	36.5	26.1	33.0
6.4	44.3	49.3	34.6	34.7
2.9	34.9	62.2	41.6	37.0
1.1	24.1	74.8	50.0	41.3
0.4	12.8	86.8	54.3	44.5
			56.2	48.9

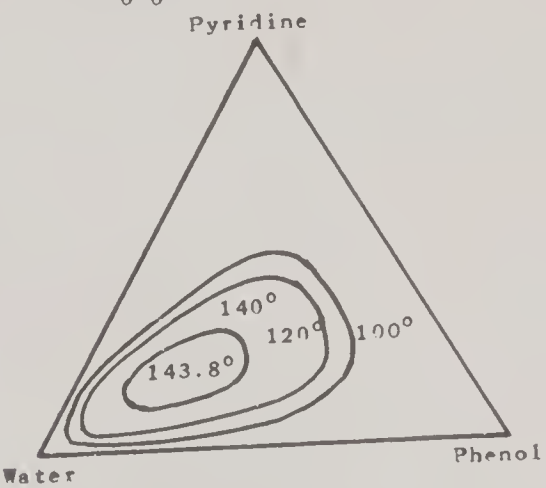
PYRIDINE

J. C. Smith, V. O. Stibolt, and R. W. Day, (Ind. Eng., 43, 190, 1951) presented complete data for the system at 15°, 45° and 60°. With rising temperature the position of the solutrope or horizontal tie line rises and reaches the peak of the curve at about 75°. At that temperature the plait point shifts from one side of the curve to the other. This is the first such system which has been thoroughly investigated.

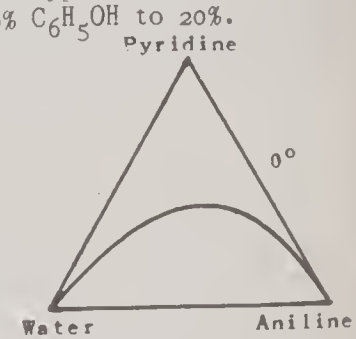
Temp.	Wt. % Pyridine in: Solutrope	At Peak
15	29.8	58.5
25	34.8	56.3
45	39.1	54.4
60	45	54.45
79.3(b.p.)	-	55.2

Additional observations were made on the system by Leikola (1940) (but no tie lines), and by Siggia and Hanna (1941), but with no numerical data and not an individual binodal curve.

PYRIDINE - C_6H_6O - Phenol (II 287).

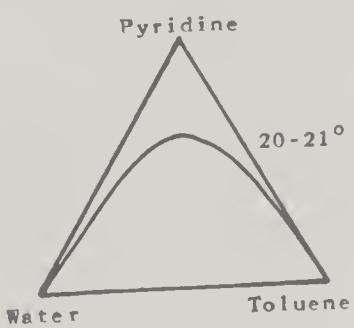


The closed curves in the graph are interpolated from Mertslin's data. Tie lines are probably longitudinal, with a plait point on each side. Correction: In the last column opposite 92.1 change 30% C_6H_5OH to 20%.



PYRIDINE - C_6H_7N, Aniline (II 288).

PYRIDINE - C_7H_8, Toluene (II 289). (Leikola, 1940).



Gms. per 100 gms. Solution (Recalculated)		
Water	Pyridine	Toluene
38.5	55.9	5.6
21.2	60.6	18.2
10.3	52.7	37.0
2.0	32.7	65.3

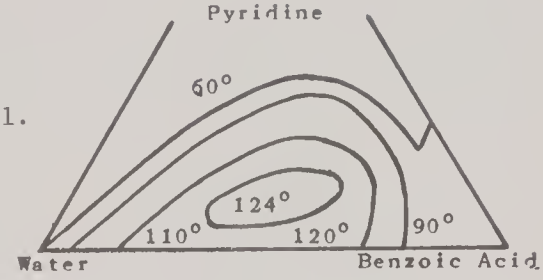
cf. also Shilow and Lepin (1922). No data on tie lines above 1% pyridine are recorded.

TERNARY AQUEOUS SYSTEMS

PYRIDINE

PYRIDINE - $C_7H_6O_2$, Benzoic Acid, C_6H_5COOH.

(E. F. Zhuravlev, Bull. Inst. Recherches. Biol. Perm. 11, 37, 1937); Chem. Abstr. 32, 2417). Graphs are interpolated from Zhuravlev's data which are similar to those for phenol. The 60° and 90° curves (metastable) are equilibria with sub-cooled benzoic acid which has a melting point in equilibrium with water of 94.6°. Closed curves were observed between 115.5°, the critical solution temperature of water and benzoic acid, and 124°, the ternary critical point.



PYRIDINE - $C_7H_7O_2N$, Anthranilic Acid, o-Aminobenzoic Acid, $NH_2C_6H_4COOH$.

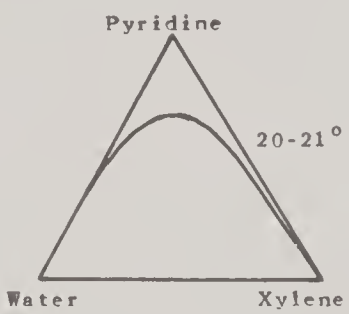
(E. F. Zhuravlev, J. Gen. Chem. (U.S.S.R.) 8, 1704, 1938; Chem. Abstr. 33, 4860).

The system is similar to that of benzoic acid and shows a triple critical point at 105°C. Anthranilic Acid has a submerged (metastable) critical solution temperature with water at 78°, below the freezing solubility curve at 104.4°.

PYRIDINE - C_8H_{10}, Xylene (II 288). (Leikola, 1940).

Gms. per 100 gms. solution at 20-21° (recalculated).

Water	Pyridine	Xylene
28.1	65.4	6.5
16.4	64.3	19.3
12.0	50.2	37.8
2.0	32.7	65.3



$C_5H_6O_4$ - Itaconic Acid $CH_2:C(COOH)CH_2COOH$.

Distribution between water and ether (II 291, ref.).

$C_5H_8O_2$ - Methyl Methacrylate. See Methanol.

$C_5H_8O_3$ - Levulinic Acid, $CH_3COCH_2CH_2COOH$.

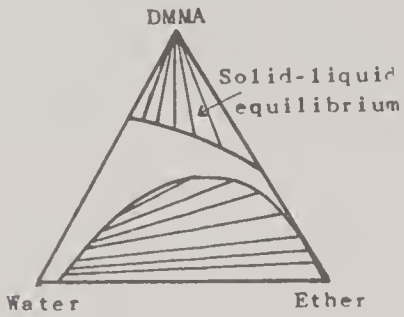
Distribution between water and chloroform, ether, or xylene (II 292-3).

$C_5H_8O_4$ - Glutaric Acid, $CH_2(CH_2COOH)_2$.

Distribution between water and chloroform or ether (II 293).

$C_5H_8O_4$ - Dimethylmalonic Acid, $(CH_3)_2C(COOH)_2$.

Distribution between water and ether or n-amyl alcohol (II 293), but extending almost to the peaks of the binodal curves (beyond it in the case of ether) so that the diagram can be inferred approximately . Corrections: The heading "Gm. Mols.", etc. was taken from the original paper, but evidently should be "Gm. equiv.". (half as much) since the solubilities are insufficient for the concentrations reported. On p. II 294 the second solvent for ethylmalonic acid should be benzene instead of ether.



$C_5H_9O_2Br$ - α Bromovaleric Acid, $CH_3CH_2CH_2CHBrCOOH$.

Distribution between water and benzene, toluene, or olive oil (II 295).

$C_5H_9O_2Br$ - α Bromoisovaleric Acid, $(CH_3)_2CHCH_2CHBrCOOH$.

Distribution between water and olive oil. (II 295).

$C_5H_9O_2K$ - Potassium Isovalerate and
$C_5H_9O_2Na$ - Sodium Valerate (Int. C-it. Tables III 422).

Distribution between water and aniline or nitrobenzene.

$C_5H_9O_3N$ - Acetylurethane $CH_3CONHCOOC_2H_5$ (II 203).

Distribution between water and olive oil.

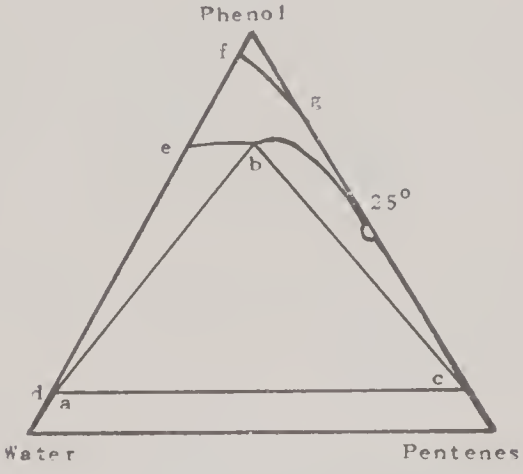
C_5H_{10} - Pentenes. See Methanol, Trichloroacetic Acid, Trichlorobutyric Acid.

PENTENES - C_5H_6O, Phenol (Francis, 1950 p. 245)

Compositions at points in gms. per 100 g liquid at 25°.

Point	Water	Phenol	Pentenes
a	91.4	8.5	0.1
b	13	74	13
c	0.2	10.8	89
d	91.3	8.7	0
e	29	71	0
f*	4.4	95.6	0
g*	0	81	19
p (plait pt.)	2	42	56

*Equilibrium with solid phenol.



The system is novel in having three liquid layers although two components are miscible as liquids. This combination is not unique, however, cf. aniline-methylcyclohexane or n-heptane and some of the other phenol systems.

C_5H_{10} - Trimethylethylene $(CH_3)_2C{:}CHCH_3$.

Water tolerance of mixtures with low concentrations of methanol, ethanol, isopropanol, and sec-butanol were presented by Ormandy, Pond, and Davies (1934) with graphs and numerical data.

$C_5H_{10}O$ - Diethyl Ketone, $(C_2H_5)_2CO$. See Ethanol.

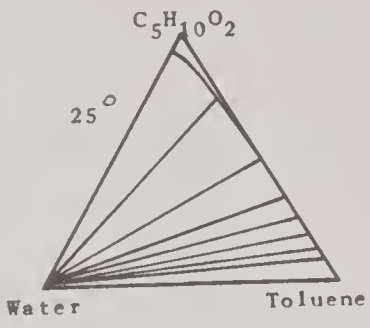
$C_5H_{10}O_2$ - n-Valeric Acid, $(CH_3(CH_2)_3COOH)$. See CCl_4.

Distribution of valeric acid between water and chloroform, 2-butanone, n- and sec-butanol, ether, petroleum ether, n- and tert-amyl alcohol, benzene, toluene, xylene, or olive oil, all at low concentrations of acid in each phase (II 301-2). The systems of petroleum ether, toluene, and xylene are solutropic, each with a horizontal tie line. Correction: In the chloroform table (II 301) read "0.390" instead of "0.890".

$C_5H_{10}O_2$ - Isovaleric Acid, $(CH_3)_2CHCH_2COOH$. See CCl_4, $CHCl_3$, Isobutanol.

Distributions are given for isovaleric acid between water and ether (II 303), olive oil (II 302), and petroleum ether (II 306) at low concentrations in each phase. The petroleum ether system is solutropic. Distributions are given also for isovaleric acid between water and EtBr, isoamyl alcohol, benzene, nitrobenzene, toluene, xylene, o-nitrotoluene (II 304-6) extending practically over the entire fields, i.e., in the case of toluene as high as 8.507 moles per liter non-aqueous layer which

is about 92% acid, and must be almost free of toluene. Graphs for all of these systems are virtually identical. Those of ethyl bromide, nitrobenzene, and o-nitrotoluene which are denser than water, each contains an isopycnic or tie line connecting compositions of equal density. Correction: In the benzene table (II 304) are three typographical errors: in column 3 for 0.8641 read 0.0641; in column 8 for 77.2921 read 7.2921; in column 9 for 0.087 read 0.097.



$C_5H_{10}O_2$, Four esters, Methyl n-Butyrate, Ethyl Propionate, n-Propyl Acetate, n-Butyl Formate. See Ethanol. For n-Propyl Acetate see also n-Propanol.

$C_5H_{10}O_3$ - Ethyl Carbonate - $(C_2H_5O)_2CO$. See Acetic Acid and Lactic Acid listed under the former.

$C_5H_{10}O_4$ - Monoacetin, $CH_2OHCHOHCH_2OCOCH_3$ with Olive Oil (II 307).

$C_5H_{11}Br$, Isoamyl Bromide, $(CH_3)_2CH\ CH_2CH_2Br$. See Ethanol.

$C_5H_{11}N$ - Piperidine, $CH_2CH_2CH_2CH_2CH_2NH$.

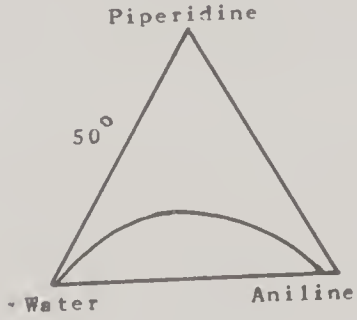
Distribution between water and chloroform, ether, benzene, or xylene in dilute solution (II 308).

PIPERIDINE - C_6H_6O, Phenol (II 308).

The fragmentary data of the table are inadequate to interpolate a curve for any one isotherm.

PIPERIDINE - C_6H_7N, Aniline (II 307).

There is little difference between the data at 0° and that at 50°; but an extra point at the latter makes it more complete.



$C_5H_{11}ON$ - Valeramide, $CH_3(CH_2)_3CONH_2$ - Olive Oil, Int. Critical Tables III 427.

$C_5H_{11}O_2N$ - Butyl Carbamate. See note under $C_2H_5O_2N$.

$C_5H_{11}O_2N$ - α Aminovaleric Acid $CH_3CH_2CH_2CHNH_2COOH$ and
α Aminoisovaleric Acid $(CH_3)_2CHCHNH_2COOH$.
See $C_4H_{10}O$, n-Butanol.

C_5H_{12} - n-Pentane. See methanol, acetic acid, ethanol, acetone.

C_5H_{12} - Isopentane, $(CH_3)_2CHCH_2CH_3$. See ethanol.

$C_5H_{12}NCl$ - ϵ-Chloroamyl Amine $Cl(CH_2)_5NH_2$ (II 318).

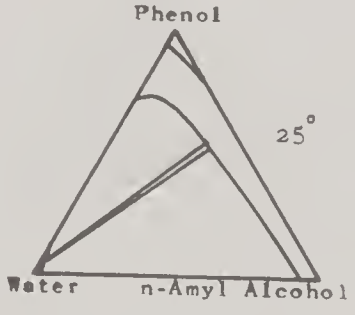
Distribution between water and tetrachloroethane, benzene, or nitrobenzene (ref.).

$C_5H_{12}O$ - n-Amyl Alcohol - $CH_3(CH_2)_4OH$. See acetaldehyde, acetic acid, acetone, ammonia, n- and iso-butyric acids, caproic acid, chloroacetic acid, dimethylmalonic acid, diethyl amine, ethanol, ethylene glycol, ethyl xanthic acid, formaldehyde, formic acid, glycolic acid, hydrogen peroxide, iodine, malonic acid, methanol, methyl amine, nitric acid, oxalic acid, n-propanol, propionic acid, trichloroacetic acid, triethyl amine, n-valeric acid.

n-Amyl Alcohol - Salting out by inorganic substances, As_2O_3 and $CdCl_2$ (Int. Critical Tables III 421); NaCl (ibid 416); H_2SO_4 (ibid 420) (salting in), other substances in Seidell I. CdI_2 370, $CsNO_3$ 315, $HAsO_2$ 113, H_3BO_3 129, $HgCl_2$ 631, KCNS 725, KCl 779, KI 822, LiCl 918-9, NH_4NO_3 315.

n-Amyl Alcohol - C_6H_6O, Phenol (II 387).

Distribution of phenol between water and amyl alcohol extending up to 53% phenol in the non-aqueous layer. The positions of the binodal curves in the graph are speculative except for their extremities.



n-AMYL ALCOHOL - $C_6H_3O_7N_3$ - Picric Acid, 2,4,6-Tri nitrophenol. (II 330).

Distribution only up to about 6% picric acid.

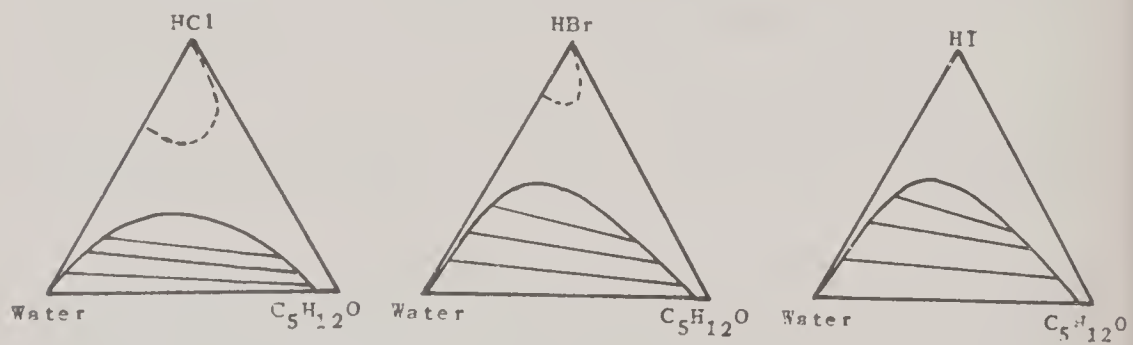
ISOAMYL ALCOHOL

$C_5H_{12}O$ - Isoamyl Alcohol $(CH_3)_2CHCH_2CH_2OH$.

See methanol, ethanol, n-propanol, isobutanol and lactic acids.

Distribution coefficients of acids between water and isoamyl alcohol: chloroacetic (II 91), isobutyric (II 255), isovaleric (II 305), malonic (II 168), phenylacetic (II 583), propionic (II 189), succinic (II 230), tartaric (II 235), and trichloroacetic (II 70). Salting out by twelve sodium salts of organic acids and three other salts (II 315). NaBr (I 1162), NaCl (Fontein 1910).

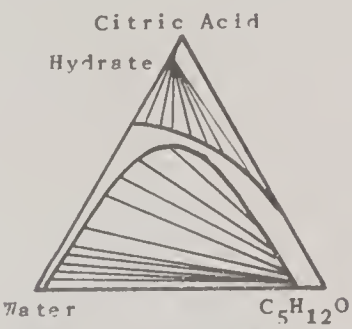
ISOAMYL ALCOHOL - Hydrogen Halides, HCl (I 574); HBr (I 568); HI (I 580).



The positions of the upper binodal curves, except their extremities, are conjectural. See note under isobutanol - HCl, HBr, HI.

ISOAMYL ALCOHOL - $C_6H_8O_7$, Citric Acid. $HOOCCOH(CH_2COOH)_2$ (II 429).

Only distributions are given, but they extend to 57% citric acid in the aqueous layer, almost a saturated solution. Correction: The headings "Gm Mols", etc., though taken accurately from the original paper, evidently should be "gm. equivalents" (one-third as much) to be within the limits of solubility. The graph is partly speculative. The upper curve shows equilibrium with solid $C_6H_8O_7 \cdot H_2O$.



$C_5H_{12}O$, 2-Methylbutanol and Diethylcarbinol. See acetic and lactic acids.

$C_5H_{12}O$, tert. Amyl Alcohol $CH_3CH_2(CH_3)_2COH$. See glycerol.

Distribution of formic (II 29), acetic (II 106), propionic (II 189), butyric (II 256), valeric (II 302), caproic (II 440) acids between water and tert. amyl alcohol. Distribution of tert. amyl alcohol between water and olive oil (II 315).

$C_5H_{12}O_4S_2$ - Dimethyl Sulfon Dimethyl Methane, $(CH_3)_2C(SO_2CH_3)_2$, or Diethyl Sulfon Methane, $CH_2(SO_2C_2H_5)_2$.

Distribution between water and olive oil (II 317).

C_5H_{12} - Petroleum Ether. Saturated hydrocarbons mostly pentanes and hexanes but often containing naphthenes or cycloparaffins. See formic acid, methanol, acetic acid, ethanol, ethyl acetate, propionic acid.

PETROLEUM ETHER - Benzoic Acid, C_6H_5COOH.

Distribution between water and "benzine" or petroleum ether (II 512-3). In both tables the system is solutropic, that is the acid dissolves by preference in the aqueous layer at low concentrations and in the hydrocarbon at higher concentrations.

$C_5H_{13}N$ - n-Amyl Amine, $CH_3(CH_2)_4NH_2$.

Distribution between water and chloroform (II 318) or xylene (II 317).

$C_5H_{13}N$ - Isoamyl Amine $(CH_3)_2CHCH_2CH_2NH_2$.

Distribution between water and ether (II 318) or xylene (II 317).

$C_6H_2O_7N_3Na$ - Sodium Picrate or Sodium 2,4,6-Trinitrophenolate, $NaOC_6H_2(NO_2)_3$. Effect of concentration in water on solubility of ether (II 276) or aniline (II 410)or nitrobenzene (Euler and Suanberg, 1917)

$C_5H_3Cl_3$ - 1,2,4-Trichlorobenzene and $C_6H_4Cl_2$, o-Dichlorobenzene.

Distribution of diethyl amine between water and chlorobenzenes. (II 279).

$C_5H_3O_7N_3$ - Picric Acid - 2,4,6-Trinitrophenol, $HOC_6H_2(NO_2)_3$.

Distribution between water and bromoform, chloroform, ether, n-amyl alcohol, benzene, toluene, or gelatin (II 330-2). The first three are solutropic on a weight basis, i.e., the picric acid dissolves first, mostly in the aqueous layer,and at higher temperatures mostly in the organic layer, especially in ether. Additional data on the benzene system are given by Walden, Ber. 34, 4191 (1901). Distribution between water and tetralin was studied by Herz, Int. Critical Tables III 428.

PICRIC ACID - C_6H_6O, Phenol.

(V. F. Ust-Kachkinstev, J. Gen. Chem. (U.S.S.R.) 7, 2069, 1937). Isotherms of the system at 35, 45, 52, 60, 65, 70, 80, 100°. These shift from three phases (solid plus two liquids) at low temperature to a simple solid-liquid line at the maximum temperature.

C_6H_5Br - Bromobenzene. See methanol, acetic acid, ethanol, acetone, n-propanol, caproic acid.

Distribution of diethyl amine between water and bromobenzene (II 279).

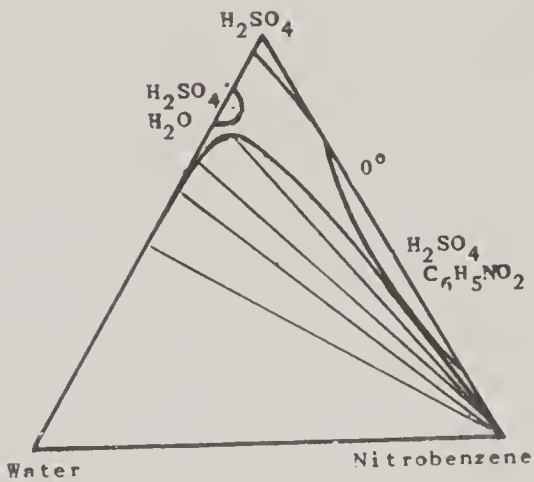
C_6H_5Cl - Chlorobenzene. See methanol, acetone, 2-butanone (or methyl ethyl ketone).

C_5H_5ONa - Sodium Phenolate or Sodium Phenate. Ether (II 276).

$C_6H_5NO_2$ - Nitrobenzene. See iodine, formic acid, methanol, acetic acid, ethanol, mono-, di-, and trichloroacetic acids, propionic acid, n- and isobutyric acids, caproic acid.

NITROBENZENE - H_2SO_4, Sulfuric Acid (II 357).

The portions of the table (II 357) marked "Total composition Wt. %" and "Wt. % composition" are confusing since they are not compositions of any phase. They have only laboratory significance;could be deleted. The compiler has used one of them, however, to help calculate the following compositions in gms. per 100 gms. liquid in equilibrium with solid phases at 0°.



Water	H_2SO_4	Nitro-benzene	Solid Phase
1.9	98.1	0	(1)
0	85.3	14.7[a]	(1)
13.7	79.7	6.6	(2)
11.2	83.9	4.9	(2)
10.8	86.2	3.0	(2)
0.0	71.5	28.5[a]	(3)
1.4	66.6	32.0	(3)
1.7	59.7	38.6	(3)
0.6	44.2	55.2	(3)
1.0	34.9	64.1	(3)

(1) H_2SO_4, m.p. 10.4°

(2) $H_2SO_4 \cdot H_2O$, m.p. 8.6°, 84.5% H_2SO_4

(3) $H_2SO_4 \cdot C_6H_5NO_2$, m.p. 11.6°, 44.4% H_2SO_4

(a) These points were calculated from the graph of Masson, J. Chem. Soc. 1931, 3200.

A fourth solid phase, nitrobenzene (m.p. 5.6°) was ignored in the original in the development of the 0° isotherm, presumably because of subcooling. The equilibrium with this phase, if it were allowed to crystallize, would "submerge" the binodal curve almost if not quite completely (cf. ethanol-benzene). One point in the table (II 357), 61.6% H_2SO_4, 38.4% $C_6H_5NO_2$, 0% H_2O, is inconsistent with the graph though copied correctly. Perhaps the percentages of $C_6H_5NO_2$ and water should be interchanged.

NITROBENZENE - Sulfuric Acid (I 500).

Bailey and Hilton's data recalculated to gms. per 100 gms. solution at 17°.

Water	H_2SO_4	Nitrobenzene
50.9	48.9	0.23
43.5	56.2	0.3
26.4	72.7	0.87
17.5	79.0	3.52
14.25	77.15	8.6
11.4	72.16	16.44
8.9	65.6	25.5
7.6	61.6	30.8
6.0	54.8	39.2
3.2	37.4	59.4
1.73	23.7	74.6
0.88	15.53	83.6
0.46	8.85	90.7
0.06	1.62	98.3

NITROBENZENE - Kerosene (Holmes, 1918).

Three layers are formed below 18° and two above 18°. No graphs or numerical data.

NITROBENZENE - Solubility in aqueous solutions of ten organic salts (II 357).

NITROBENZENE - $C_8H_8O_2$, Phenylacetic Acid, $C_6H_5CH_2COOH$ (II 583).

Distribution extending to high concentrations of acid, about 35% in the nitrobenzene layer.

$C_6H_5O_3N$ - o-Nitrophenol, $HOC_6H_4NO_2$.

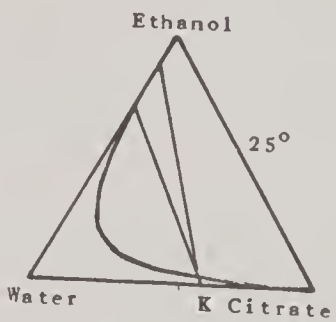
See methanol, ethanol. Effect of o- and p-nitrophenol on the critical solution temperature of water and phenol (II 380). The ortho isomer has about thirty times as much effect as the para isomer. Correction: In the table "complete miscibility" should be "incomplete miscibility" (four times including the footnote).

$C_6H_5O_3N$ - m-Nitrophenol. See ethanol.

$C_6H_5O_3N$ - p-Nitrophenol. See methanol, ethanol, o-nitrophenol.

$C_6H_5SO_3Na$ -Sodium Benzene Sulfonate. Solubility of ether (II 275), isoamyl alcohol (II 315) or aniline (II 407) in aqueous solutions of $C_6H_5SO_3Na$.

$C_6H_5O_7K_3$ - Potassium Citrate, $KOOCCOH(CH_2COOK)_2$. (H_2O - Ethanol I 709).



$C_6H_5O_7Na_3$ - Sodium Citrate. Solubility of ether (II 275), isoamyl alcohol (II 315), and aniline (II 409).

BENZENE

C_5H_5 - Benzene. See acetaldehyde, acetic acid, acetone, butanols, n-butyric acid, caproic acid, chloroacetic, dichloroacetic, trichloroacetic acids, dioxane, ethanol, ethyl acetate, formic acid, isobutyric acid, isovaleric acid, methanol, n- and isopropanols, propionic acid, pyridine,

Distributions between water and benzene are given for the following substances.

Br_2 I 210
HCN I 570
HCl I 575
H_2O_2 I 590
H_2S ICT III 420
Acetanilide II 605
Acetyl o-Toluidine ICT III 431
Aminoazobenzene II 705
Aniline II 416
Anisidine II 560
Anthranilic Acid II 540 (ref.)
Benzoic Acid II 510-12[b], 515
Benzyl Amine II 554
Bromoacetic Acid II 86
m- and p-Bromoanilines ICT III 428
α-Bromobutyric Acid II 238
α- and β-Bromovaleric Acid II 295
α-Bromoisovaleric Acid II 295
Caproic Acid II 438-9
Chloral Hydrate II 93
ε-Chloroamyl Amine II 318
o-, m-, and p-Chloroanilines II 372
β-Chloropropionic Acid II 171
Crotonic Acid II 222
Cyanoacetic Acid II 164
Diethyl Amine II 279-80
Diethyl Tartrate ICT III 431
Dimethyl Amine II 160
3, 5-Dinitrobenzoic Acid II 471
$HgBr_2$ I 611[a]
$HgCl_2$ I 631
I_2 I 666
N_2H_4 I 1028
Dipropyl Amine II 466
Hydroxyazobenzene II 700
Hydroxyquinoline ICT III 431
Iodoacetic Acid II 94
β-Iodopropionic Acid II 172
Isocaproic Acid II 438
Mandelic Acid II 595[c]
Methyl Amine II 65
β-Naphthol II 660
α- and β-Naphthyl Amine II 665
o-, m-, and p-Nitroanilines ICT III 428
o-Nitrobenzoic Acid II 488, 491
m-Nitrobenzoic Acid II 488
p-Nitrosomethylaniline ICT III 430
p-Nitrosodimethylaniline ICT III 431
Phenolphthalein ICT III 432
Phenylacetic Acid II 583
o- and m-Phenylene Diamine II 424
Picric Acid II 330-2
Piperidine II 308
Resorcinol II 396
Salicylic Acid II 524-5
o-, m-, p-Toluidines II 558
Trichlorobutyric Acid II 220
Triethyl Amine II 468[d]
Trimethyl Amine II 212
Valeric Acid III 301-2

ICT = Int. Critical Tables.

(a) Correction: All six of the concentrations under "C_6H_6 layer" should be divided by ten.

(b) J. C. Chu, C. C. Taylor, and D. J. Levy, Ind. Eng. Chem. 42, 1157 (1950) gave distributions in presence of wetting agents for $C_B \times 10^4$ = 19.8 to 34.4 and $C_W \times 10^4$ = 3.1 to 6.52.

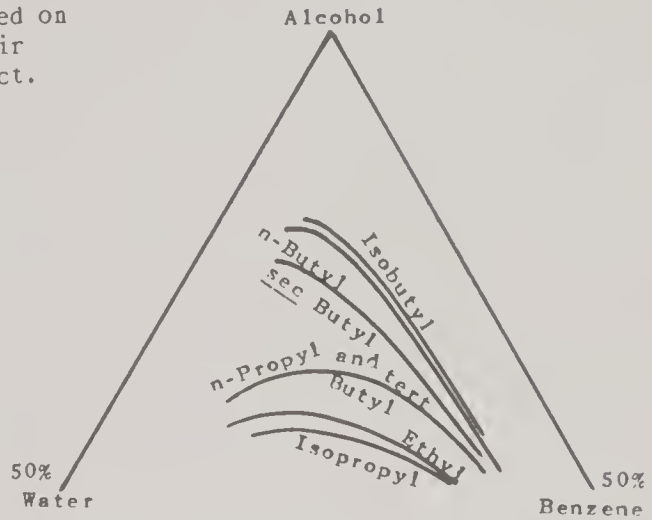
(c) Also Smith and White (1929).

(d) Also R. Linke, Oel u. Kohle 39, 31/32 723 (1939).

BENZENE - $AgClO_4$, Silver Perchlorate (I 54) Several complex isotherms are shown in the original.

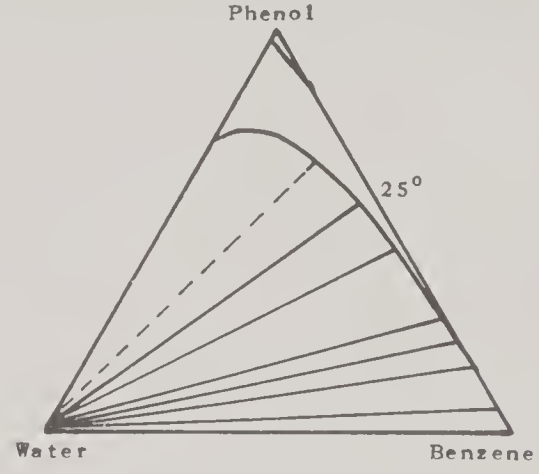
BENZENE - Alcohols. (Ormandy, Pond, and Davies, 1934).

Seven alcohols are plotted on the same graph to show their relative homogenizing effect. The numerical data are too numerous to reproduce.



BENZENE - C_6H_6O - Phenol, C_5H_5OH (II 369, 378-9, 385, 387).

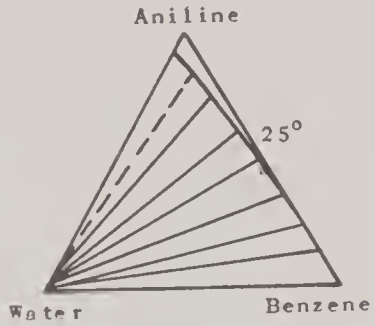
Corrections: On II 369 in the upper table under C_6H_5OH instead of "29.29" read "70.70". In the note near the bottom of the same page the system studied by Mertslin (Merclin) involved benzine (gasoline) not benzene. On II 379 in the last column of the upper table instead of "59.23" read "95.23". The two halves of the table should be entitled "Organic Layer" and "Aqueous Layer" because in the last two items the aqueous layer is the upper layer (cf. II 369). There is an isopycnic (dashed tie line) at which the two layers have the same density (calcd. at about 22% benzene in the organic layer). In Vauble's table (II 387) read "0.1788" instead of "0.1188". The distributions opposite "150 cc" are evidently incorrect. In Schweissinger's table (II 389) the heading should be gms. C_6H_5OH per 100 gms. solution at:".



Rathmann (1937) presented a graph but no numerical data for this system. His curve is closer to the right side line than the one shown here.

BENZENE - C_6H_7N, Aniline, $C_6H_5NH_2$ (II 416) .

(Griswold, Chew, and Klecka, 1950). Gms. per 100 gms. liquid.



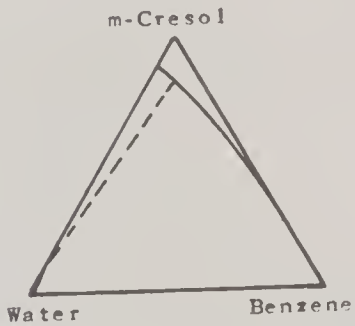
Aqueous Layer		Organic Layer
Aniline[a]	Water[b]	Aniline
3.66	5.22	94.78
2.75	2.7	75.60
2.38	1.8	63.82
2.07	0.9	47.34
1.71	0.55	35.57
1.18	0.27	24.30
0.78	0.2	11.21

(a) Benzene below 0.3.

(b) Interpolated from curve.

Similar data are given at 50°. The system contains an isopycnic (dashed line) or tie line connecting compositions with equal density (position estimated).

BENZENE - C_7H_8O, m-Cresol, $CH_3C_5H_4OH$, (Rathmann, 1937).



Gms. per 100 gms. solution (Temperature not stated)

Water	Cresol	Benzene
12.8	87.2	0.0
9.7	80	10.3
4.0	54.1	41.9
2.1	34.5	63.4
0.9	20.0	79.1
0.5	14.9	84.6

The position of the isopycnic is estimated.

BENZENE - Sodium Oleate.

E. L. Smith (1932) presented a complex isotherm for this system.

BENZENE - Gasoline. Water tolerance (I 588).

C_6H_6O - Phenol, C_6H_5OH.

See acetic acid, acetone, n-amyl alcohol, benzene, cyclohexane, ethanol, formic acid, glycerol, lactic acid, methanol, o- and p-nitrophenol, oxalic acid, pentenes, picric acid, piperidine, pyridine, succinic acid, tartaric acid, trichloroacetic acid.

PHENOL. Salting out with inorganic salts:

$AgNO_3$ (I 66), $BaCl_2$ (II 376), $Ba(NO_3)_2$ (I 174), $Ba(OH)_2$ (I 178), $CaCl_2$ (II 376), $Ca(OH)_2$ (I 315), $Hg(CN)_2$ (I 617), KBr (Timmermans, 1907), KCl (I 779, II 376), KI (I 822), KNO_2, KNO_3 (Timmermans, 1907), KOH (I 852, ref.) K_2SO_4 (I 876), LiCl (II 376), (Schryver, 1910), LiOH (I 980), $MgCl_2$ (II 376, Schryver, 1910), $MgSO_4$ (I 995), NaBr, NaCNS (Schryver, 1910), NaCl (II 376), NaF (Schryver, 1910), $NaNO_3$ (Int. Critical Tables III 402 ref.), NaOH (I 1173), Na_2SO_4 (Int. Critical Tables III 409), $SrCl_2$ (II 376, Schryver, 1910), $Sr(OH)_2$ (I 1519, ref.).

PHENOL - Salting out with sodium salts of organic acids: Acetate (I 1169, ref.) benzoate, formate, lactate, maleate, mono, di, and trichloroacetates, salicylate, succinate, tartrate (Schryver, 1910).

PHENOL.

Distribution between water and organic liquid is given for bromoform and carbon disulfide (Int. Critical Tables III 428), carbon tetrachloride (solutropic), chloroform (II 386), collodion (II 387), sec-octyl alcohol and olive oil (II 379), pentachloroethane (solutropic), tetrachloroethane, tetrachloroethylene, trichloroethylene (solutropic), xylene (II 386). The last system contains an isopycnic (tie line connecting compositions of equal density).

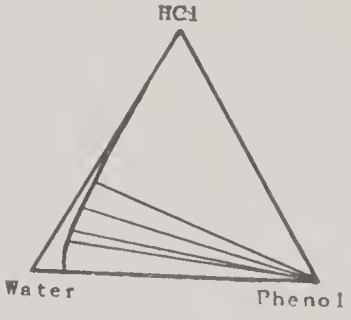
PHENOL.

Distribution between water and phenol of H_2O_2 (I 590), succinic acid (II 230).

PHENOL.- H_3BO_3, Boric Acid, H_3BO_3 (I 125, ref.).

PHENOL - HCl, Hydrogen Chloride (I 573).

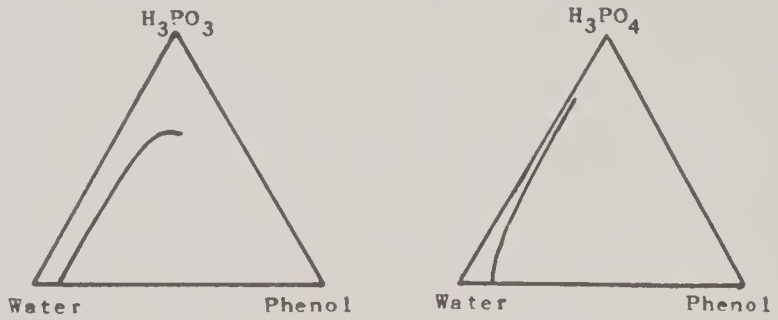
No data are available for the upper right half of the graph which should be of much interest. It would involve high pressure.



PHENOL - H_2D, Heavy Water. (II 376).

Effect of H_2D on critical solution temperature of phenol-water.

PHENOL - H_3PO_3, Phosphorous Acid (II 377).



PHENOL - H_3PO_4, Phosphoric Acid (II 377).

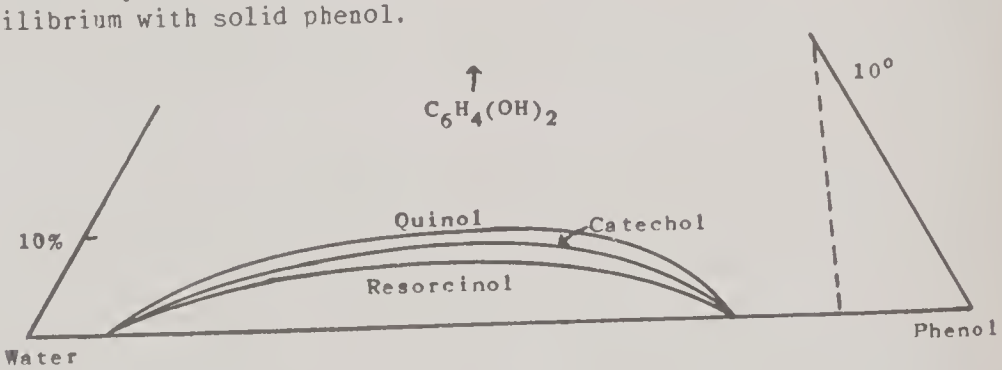
(Walton and Kepfer, J. Phys. Chem. 34, 543, 1930); (Ust-Kachkintsev, J. Gen. Chem. (U.S.S.R.) 7, 2069, 1937) Isotherms at 60°, 100°, 130°, 150°, with triple critical points.

PHENOL - H_2SO_4, Sulfuric Acid (I 600, ref.).

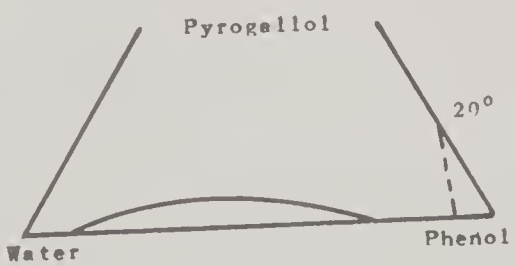
(Ust-Kachkintsev, 1937) Isotherms with triple critical points.

PHENOL - $C_6H_6O_2$, Catechol, o-$C_6H_4(OH)_2$ (II 381); Resorcinol (meta isomer) (II 382) and Hydroquinone or quinol (para isomer) (II 398-9).

The nearly vertical dashed line is the approximate position of the equilibrium with solid phenol.



PHENOL - $C_6H_6O_3$ - Pyrogallol, $C_6H_3(OH)_3$ (1,3,5). (II 377).

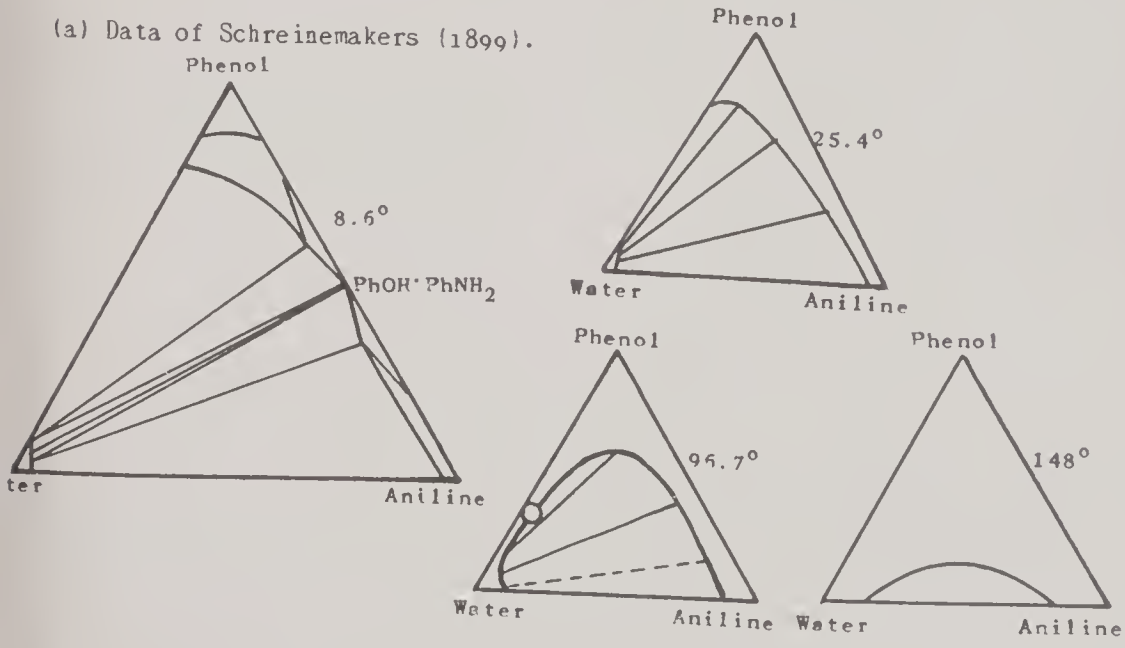


PHENOL - C_5H_7N, Aniline, $C_6H_5NH_2$ (II 415).

A. N. Campbell, J. Am. Chem. Soc., 67, 981, 1945). Compositions in gms. per 100 gms. solution.

Aqueous Layer			Temp.	Organic Layer		
Water	Phenol	Aniline		Water	Phenol	Aniline
96.6	0	3.4	8.6	4.8	0.0	95.2
96.5	0.4	3.1		5.3	10.2	84.5
96.3	1.1	2.6		4.6	25.7	69.7
96.2	0.9	2.9		4.2	29.3	66.5
94.6	4.4	1.0		3.9	63.0	33.1
92.8	6.8	0.4		15.3	75.0	9.7
93.1	6.9	0.0		24.4	75.6	0.0
96.4	0.0	3.6	25.4	6.2	0.0	93.8
96.7	1.2	2.1		5.6	31.7	62.7
94.5	4.7	0.8		8.5	66.2	25.3
93.3	6.5	0.2		18.5	75.0	6.5
91.6	8.4	0.0		28.7	71.3	0.0
95.9	0.0	4.1	48.0	6.2	0.0	93.8
91.7	7.4	0.9		16.3	69.0	14.7
87.6	12.4	0.0		37.0	63.0	0.0
95.1	0.0	4.9	66.3	7.2	0.0	92.8
88.5	10.8	0.7		30.0	61.3	8.7
80.5	19.5	0.0		51.1	48.9	0.0
89.0	10.1	0.9	69.6	27.4	63.7	8.9
64.7	35.0	0.3		Near critical solution pt.		
93.0	0.0	7.0	96.7	10.5	0.0	89.5
92.7	0.5	6.8	(isopycnic)	13.8	17.3	68.9
92.4	4.0	3.6		17.1	37.9	45.0
84.2	13.6	2.2		32.3	52.4	15.3
59.8	35.5	4.7		Plait Pt.		
83.5	0	16.5	148[a]	20	0	80
				33	16.4(Max.)	50.6
65	13.2	21.8		Plait Pt.		

(a) Data of Schreinemakers (1899).



PHENOL

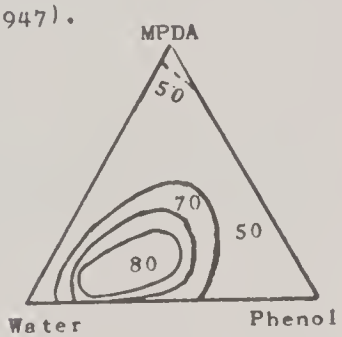
Solutions in equilibrium with a solid phase.

Solid	Temp	Water	Phenol	Aniline
Compound	8.6	96.2	3.0	0.8
"	"	95.3	3.8	0.9
Phenol	"	17.7	82.3	0
"	"	2.7	81.5	15.8
Compound	"	3.0	72.2	24.8
"	"	0.0	17.0	83.0
"	25.4	0.0	32.0	68.0
"	"	0.0	66.5	33.5
"	"	3.1	55.0	41.9
Phenol	"	0.0	84.5	15.5
"	"	4.5	95.0	0.0

In most cases the aqueous layer is the upper one, but above 77° it is heavier than the aniline layer. There is an isopycnic or tie line connecting compositions of equal density (dashed line) in the third isotherm.

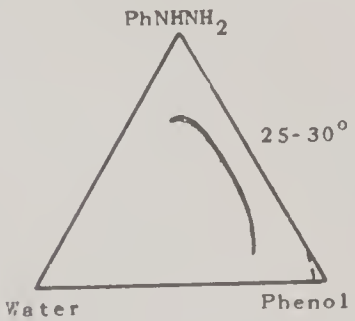
PHENOL - $C_6H_8N_2$, m-Phenylene Diamine, $C_6H_4(NH_2)_2$ ('MPDA').

(E. F. Zhuravlev and M. N. Bychkova, J. Gen. Chem. (U.S.S.R.) 17, 1577, 1947).



Fifty-three observations of solution temperatures with various binary and ternary mixtures are given, from which the isotherms are interpolated. The ternary critical solution temperature is 85.5°. The dotted line near the top is the equilibrium with solid MPDA. (m.p. 63°) (position estimated by compiler).

PHENOL - $C_6H_8N_2$, Phenyl Hydrazine, $C_6H_5NHNH_2$ (II 380).



Numerous data at various temperatures are given. The isotherm is an interpolation. Correction: The first item "50" in column 6 should be "40" (opposite 20.2°).

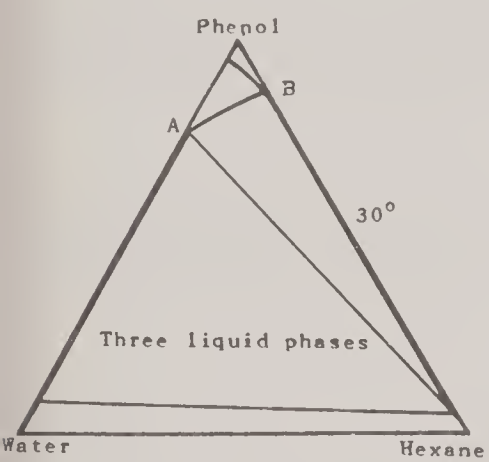
PHENOL - $C_6H_{11}O_2Na$, Sodium Caproate (I 1173, ref.).

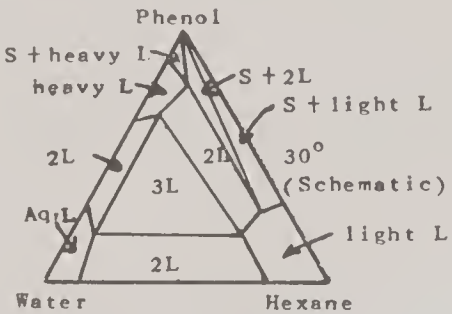
PHENOL - C_6H_{12}, See Cyclohexane.

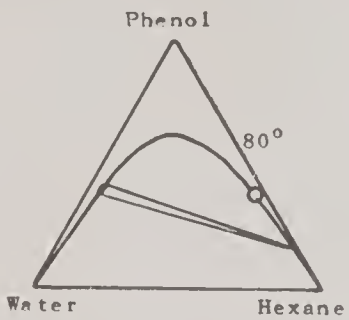
PHENOL - C_6H_{14}, n-Hexane (II 457) or 2-Methylpentane (II 459).

Vondracek and Dostal observed and reported only the line AB in these systems without apparently noticing that the bulk of the compositions separate into three liquid layers. The aqueous and phenolic layers require hours to separate because of the closeness in density, low surface tension and high viscosity.

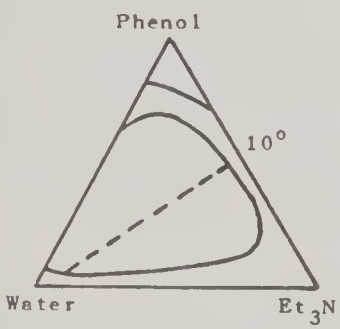
The large graph is drawn to scale and applies to both hexanes; the first small one is schematic and distorted to show the phase relations. On heating, the solid phase disappears at 41°, (m.p. of phenol); the two liquid region on the right side recedes from the border at 51° (C.S.T. of phenol-hexane); the two liquid region on the left side recedes from the border at 66° (C.S.T. of phenol-water). The three liquid region collapses as in the third graph and disappears at about 80°, forming a simple binodal curve. Correction: In the lower table on p. II 459 the headings are interchanged. They should have been in the order H_2O, C_6H_{14}, C_6H_5OH at both temperatures.

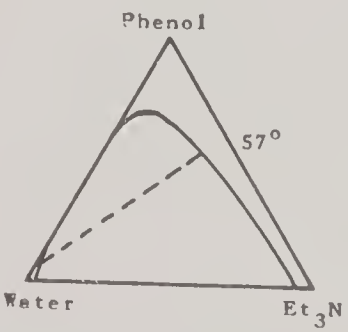






PHENOL - $C_6H_{15}N$, Triethyl Amine (Int. Critical Tables III 415).





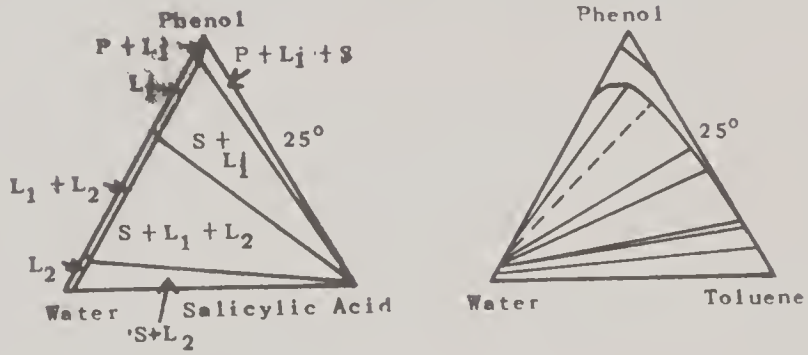
Each graph has an isopycnic or tie line connecting compositions of equal densities.

TERNARY AQUEOUS SYSTEMS

PHENOL

PHENOL - $C_7H_6O_2$, Benzoic Acid, C_6H_5COOH (II 509, ref.).

PHENOL - $C_7H_6O_3$ - Salicylic Acid, $o\text{-}HOC_6H_4COOH$ (II 383-4, 389, 524).



PHENOL - C_7H_8, Toluene (II 379, 386).

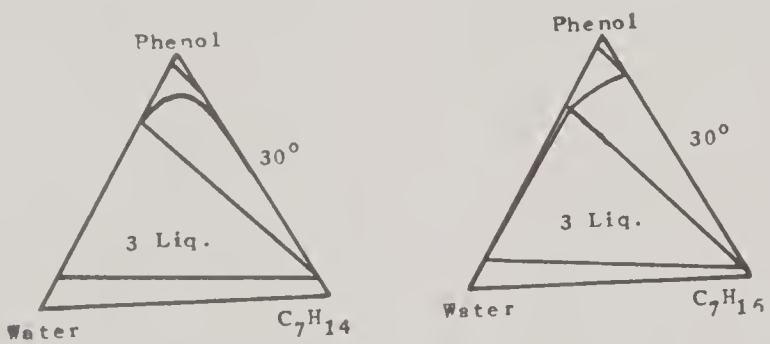
Only distribution is reported, but combination with the binary solubilities gives the complete graph with fair precision. The dashed line is an isopycnic or tie line connecting compositions of equal densities.

PHENOL - C_7H_8O, o-, m-, and p-Cresols. $HOC_6H_4CH_3$.

Paris and Vial (1948) observed the effects of various percentages of cresols on cloud points of phenol water mixtures as a means of analysis of phenols. The data are numerous, but not suitable for plotting ternary isotherms.

PHENOL - C_7H_{14}, Methylcyclohexane and
C_7H_{16}, n-Heptane (II 379, 563)

These two systems separate into three liquid phases, cf. note under phenol-hexanes.



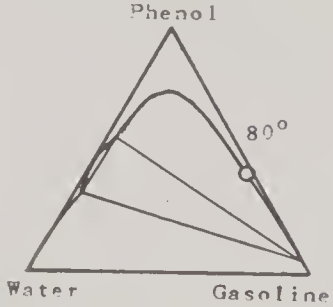
Correction: In the upper table (II 563) the headings of the first column at each temperature should be C_7H_{16} instead of C_7H_{14}.

PHENOL - Gasoline.

Mertslin (J. Gen. Chem. (U.S.S.R.) 8, 1742 (1938)) observed isotherms at 80° and 90°. He called the hydrocarbon "benzine" but it was not "benzene" as designated in Chem. Abstracts 33, 4859 (cf. also II 369). Three liquid layers were observed for certain compositions, but the lower portion of the diagram is only approximate.

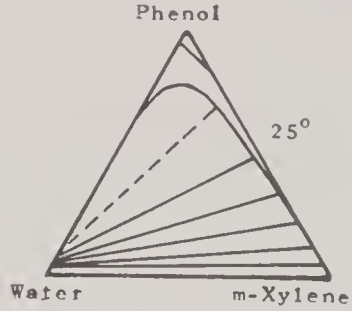
Compositions in gms. per 100 gms. satd. solution.

Water	Phenol	Gasoline
3.0	47.0	50.0
5.0	65.0	30.0
15.7	76.3	8.0
30.0	66.0	4.0



PHENOL - C_8H_{10}, m-Xylene, $C_6H_4(CH_3)_2$. (II 386).

Cf. note under phenol-toluene.



PHENOL - $C_8H_{18}O$, sec-Octyl Alcohol ($CH_3(CH_2)_5CHOHCH_3$. (II 379).

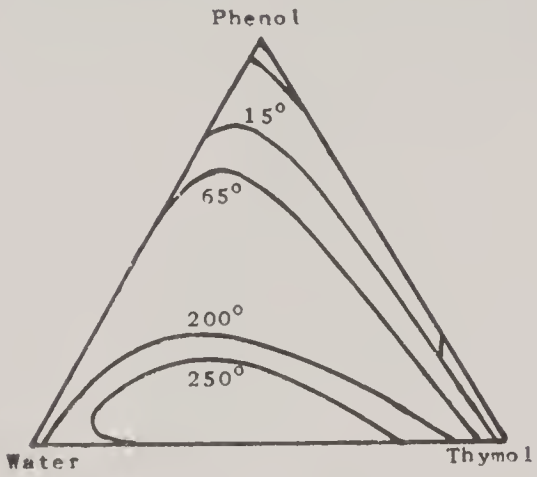
PHENOL - $C_{10}H_8$, Naphthalene.

This system was studied also by Timmermans (1907). The graph in Int. Critical Tables III 409 erroneously indicates complete miscibility of water and naphthalene.

Boutaric and Nabot (1923) studied the effects of naphthalene, azobenzene, naphthyl amine, salol, and anthraquinone on miscibility of water and phenol (II 373).

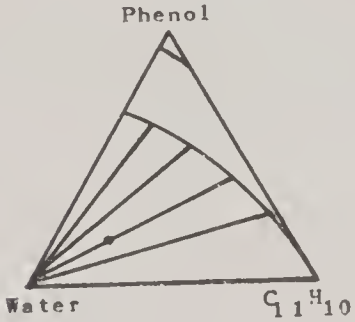
PHENOL - $C_{10}H_{14}O$, Thymol, 3-Methyl-6-Isopropylphenol. (II 385).

The note at the bottom of II 673, which was taken from the paper by Wilcox and Bailey, is inaccurate. The critical temperatures of thymol and water are 415° and 374° respectively, far above the observed critical point, 270° which must be the critical solution temperature. The compiler has checked this observation experimentally. The positions of the lines for equilibrium with solid phenol and thymol at 15° are speculative. At each temperature there is probably an isopycnic or tie line connecting compositions of equal density, but data for estimating their positions are lacking.



PHENOL - $C_{10}H_{16}O$, Camphor (II 389, ref.).

PHENOL - $C_{11}H_{10}$, Methylnaphthalene (Prutton, Walsh, and Desai (1950)).

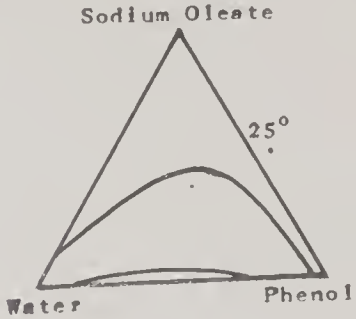


Lower Layer			Upper Layer ($C_{11}H_{10}$ negligible)	
Water	Phenol	$C_{11}H_{10}$	Water	Phenol
0	0	100	100	0
1.9	26.8	71.3	96.2	3.8
6.0	42.0	52.0	93.7	6.3
14.5	55.5	30.0	93.0	7.0
18.1	62.0	19.9	92.2	7.8
28.7	71.3	0.0	91.6	8.4

The methylnaphthalene was estimated to be 95% α and 5% β isomer. The short line near the top for solid phenol was added by the compiler.

Solubility of benzil and hexamethyl mellitate in aqueous solutions of phenol are given by Timmermans (1907).

PHENOL - $C_{18}H_{33}O_2Na$, Sodium Oleate (I 1188, II 377, 389).



$C_6H_6O_2$ - Catechol (Pyrocatechol) See Phenol.

$C_6H_4O_2$. Resorcinol. See Phenol.

Distribution between water and CCl_4, ether, benzene or olive oil (II 396). There seems to be a discrepancy in the ether distribution since a larger volume of ether is reported to dissolve a smaller quantity of resorcinol.

$C_6H_6O_2$ - Hydroquinone (Quinol). See Phenol.

Distribution between water and ether. (II 400).

$C_6H_6O_2N$ - o-, m-, and p-Nitroanilines.

Distribution between water and benzene (Int. Critical Tables III 428). Ortho isomer with n-heptane (II 402).

$C_6H_6O_3$ - Pyrogallol (1,2,3-Trihydroxybenzene). See Phenol.

C_6H_7N - Aniline - $C_6H_5NH_2$.

See acetic acid, acetone, benzene, n-butyric acid, ethanol, ethyl acetate, formic acid, glycerol, lactic acid, methanol, nitrobenzene, phenol, piperidine, n- and isopropanols, propionic acid, pyridine.

ANILINE.

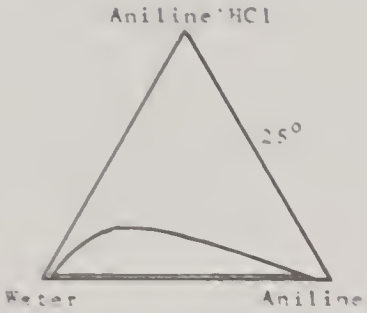
Distribution between water and benzene, carbon tetrachloride, ether, toluene, and xylene (II 416). All but the carbon tetrachloride system would have isopycnics, since some mixture of aniline and the light solvent would have the same density as the aqueous layer.

Aniline solubility in aqueous solutions of about 34 inorganic and 20 organic salts (II 407-10); and in five other organic salts (Euler and Suanberg , Z. Elektrochem. 23, 192, 1917).

Distribution between water and aniline of $AgNO_3$ (I 66), H_2O_2 (II 590), methylene blue (II 749).

ANILINE - $AgClO_4$. Silver Perchlorate. A complex isotherm at 25° (I 50).

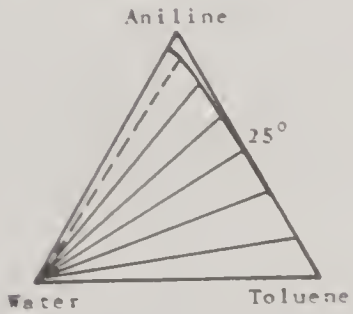
ANILINE - C_6H_8NCl, Aniline Hydrochloride (II 407, 411-2, 420).



ANILINE - C_6H_{12}, Cyclohexane, effect of water on aniline point of cyclohexane. Schlegal (1034).

ANILINE - C_6H_{14}, n-Hexane. (Drucker 1023).

ANILINE - C_7H_8, Toluene (II 416, J. C. Smith and R. E. Drexel, Ind. Eng. Chem. 37, 601, 1945)



Gms. per 100 gms. satd. solution at 25°

Aqueous Layer		Organic Layer	
Aniline	Toluene	Water	Aniline
0.0	0.040	0.05	0.00
1.2	0.06	0.07	15.5
1.0	0.06	0.25	34.0
2.3	0.06	0.7	50.7
2.7	0.06	1.0	65.1
3.1	0.06	3.3	78.7
3.66	0	5.05	94.95

The isopycnic (dashed line) reaches 90% aniline. Above this the aniline layer is the heavier.

ANILINE - C_7H_{14}. Methylcyclohexane.

Griswold, Chew, and Klecka (1950). This system separates into three liquid layers with compositions in gms. per 100 gms. solution as follows:

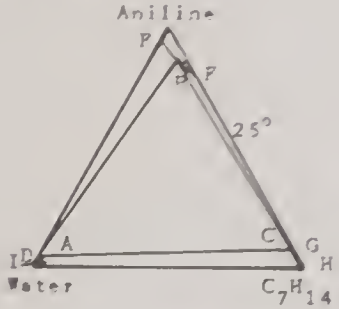
Temperature 25°

Point	Water	Aniline	C_7H_{14}
A	95.63	3.77	0.6
B	2.2	85.36	12.44
C	0.2	8.72	91.08
D	96.40	3.60	0
E	5.21	94.79	0
F	0	83.3[a]	16.7[a]
G	0	12.02	87.98
H	0.07	0	99.93
I	99.9	0	0.1

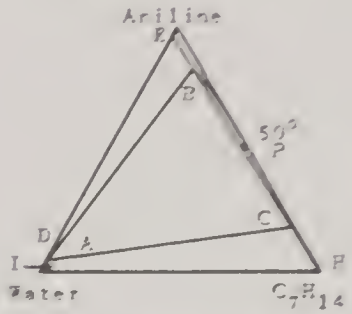
Temperature 50°

Point	Water	Aniline	C_7H_{14}
A	95.37	3.43	0.18
B	4.5	79.79	15.71
C	0.6	20.02	79.38
D	95.6	4.4	0
E	6.5	93.5	0
P[b]	1.13	50.64	48.23
H	0.37	0	99.63
I	99.9	0	0.1

(a) Extrapolated



(b) Estimated



The binodal area BPGC recedes from the side line at 40° the C.S.T. of aniline and methylcyclohexane, but remains as a thin loop BPC with a plait point P. At some unknown higher temperature points B and C would undoubtedly merge and the system would resemble the benzene-aniline system (q.v.). Correction: In Table II of the original the hydrocarbon headings for this system were inadvertently entitled "n-Heptane".

ANILINE - C_7H_{16}. n-Heptane (Griswold, Chew, and Klecka, 1950).

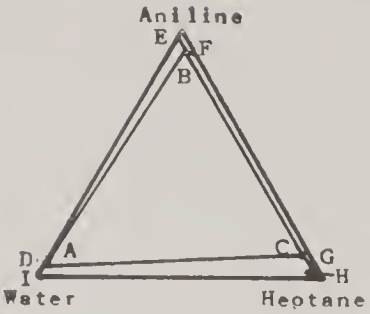
Three liquid phases with compositions in gms. per 100 gms. as follows:

Temperature 25°

Point	Water	Aniline	C_7H_{16}
A	95.33	3.6	0.07
B	2.1	92.6	5.3
C	0.04	6.22	93.74
D	96.34	3.66	0
E	5.22	94.78	0
F	0	93.57	6.43
G	0	7.50	92.50
H	99.96	0	0.03
I	0.015	0	99.985

Temperature 50°

Point	Water	Aniline	C_7H_{16}
A	95.6	4.0	0.4
B	4.4	87.25	8.35
C	0.2	11.15	88.65
D	95.8	4.20	0
E	6.4	93.60	0
F	0	85.30	14.70
G	0	13.72	86.28
H	0.02	0	99.98
I	99.91	0	0.09



Many additional points on the binodal curves and tie lines were reported. The binodal area BFGC would recede from the side line at 70°, the C.S.T. of aniline-n-heptane.

ANILINE - Xylene. Distribution (II 416)

ANILINE - Kerosene (b.p. 200-230°).

Holmes (1918) described this as a system separating into three liquid layers.

ANILINE - Methylene Blue (II 752, ref.)

ANILINE - Four vegetable oils.

Effect of water concentration in aniline on the cloud point with rape, soya, peanut, and corn oils (II 415).

C_6H_7N, γ-Picoline (4-Methylpyridine).

Salting out with zinc chloride (II 420).

C_6H_8NCl, Aniline hydrochloride - $C_5H_{12}O$, Isoamyl alcohol (II 315); Paraldehyde (II 442); Aniline (II 407, 411-2, 420). See aniline.

$C_6H_8N_2$, o- and m-Phenylene Diamines, $C_6H_4(NH_2)_2$. See Benzene.

For the meta isomer see also phenol.

$C_6H_8N_2$, Phenylhydrazine, $C_6H_5NHNH_2$. See phenol

$C_6H_8N_2O_3$, Aniline Nitrate. See nitrobenzene.

$C_6H_8N_2O_3$, Picoline Nitrate. See nitrobenzene.

$C_6H_8O_7$, Citric Acid, $HOOCCH_2COH(COOH)CH_2COOH$.

Correction: In the middle table on II 427 the empirical formula is given incorrectly seven times as $C_6H_7O_7$.

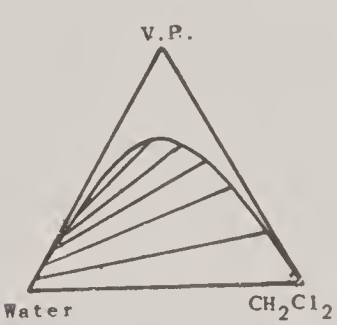
Distribution of citric acid between water and ether (II 428) or isoamyl alcohol (II 429). In the latter table the heading instead of "Gm. Mols.", etc. should be "Gm. equiv. $C_6H_8O_7$ per liter" (one third as much) though copied correctly from the original.

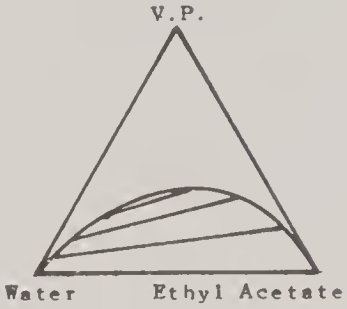
TERNARY AQUEOUS SYSTEMS

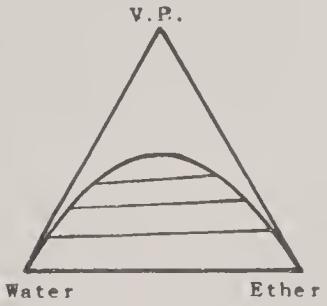
C_6H_9ON, Vinylpyrrolidone, $CH_2{:}CHNCOCH_2CH_2CH_2$ (V.P.).

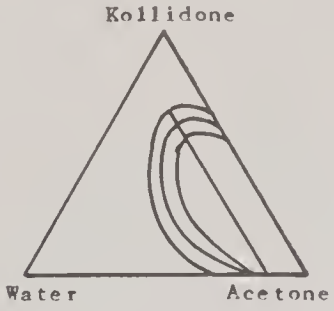
(J. W. Copenhaver and M. H. Bigelow, Acetylene and Carbon Monoxide Chemistry. Reinhold Pub. Corp., New York, 1949, pp. 76-9).

VINYL PYRROLIDONE - CH_2Cl_2, Methylene Chloride
- $C_4H_8O_2$, Ethyl Acetate
- $C_4H_{10}O$, Ether









The altitudes of the first three curves are about 60, 33, and 45% vinyl pyrrolidone by weight, respectively. Kollidone is a polymer of vinyl pyrollidone. The three curves are for polymers with three different viscosities. The axis or tie line is only approximate. No numerical data are given for any of the systems.

$C_6H_9NSO_4$, Aniline Sulfate - Aniline (II 410).

C_6H_{10}, Cyclohexene - $CH{:}CH_2CH_2CH_2CH_2$. See methanol, ethanol, and isopropanol.

$C_6H_{10}O$, Cyclohexanone. See acetic acid.

$C_6H_{10}O$, Mesityl Oxide, $(CH_3)_2C{:}CHCOCH_3$. See acetic acid.

$C_6H_{10}O$, Allyl Ether $(CH_2{:}CHCH_2)_2O$. See allyl alcohol.

$C_6H_{10}O_2$, Methyl Vinyl Carbinol Acetate. See 2,3-butene glycol.

$C_6H_{10}O_3$. Ethyl Acetoacetate $CH_3COCH_2COOC_2H_5$. Salting out with NaCl, $NaNO_3$. Int. Critical Tables III 416.

$C_6H_{10}O_4$. Ethylene Diacetate or Ethylidine Diacetate.

See acetic acid.

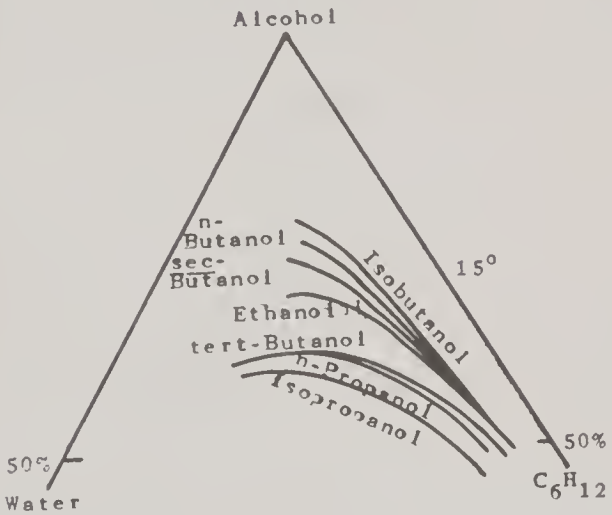
$C_6H_{11}O_2N_2Br$. Bromoural.

Distribution between water and olive oil (Int. Critical Tables III 428).

C_6H_{12}. Cyclohexane.

See methanol, acetic acid, ethanol, acetone, β-chloroethanol, aniline, n- and isopropanol.

CYCLOHEXANE - Seven alcohols.



(Ormandy, Pond and Davies 1934). The numerical data are given in minimum alcohol strengths miscible with various proportions of hydrocarbons, and are too numerous to reproduce here.

CYCLOHEXANE - Phenols.

The distribution of nineteen phenols between water and cyclohexane was observed as a function of hydrogen ion concentration by C. Golumbic, M. Orchin, and S. Weller, J. Am. Chem. Soc., 71, 2624 (1949) and by Orchin and Golumbic, ibid. 4151. The phenols included phenol, three cresols, four xylenols, three ethylphenols, 3-methyl-5 ethylphenol, o-phenylphenol, o- and p-cyclohexylphenol and four complex phenols. Golumbic, (ibid, 2627) used the results to make a separation of some isomeric phenols.

C_6H_{12} - Methylcyclopentane.

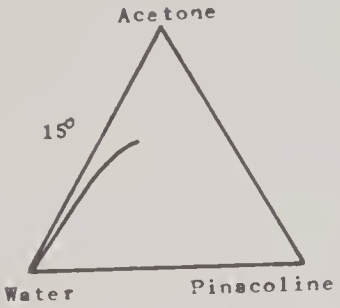
Solubility in water is increased by potassium oleate up to 2% under certain conditions. McBain and O'Connor (1940).

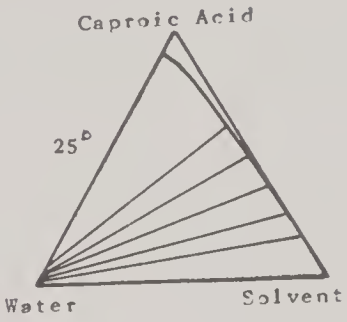
$C_6H_{12}O$ - Methyl Isobutyl Ketone $CH_3COCH_2CH(CH_3)_2$.

See acetic acid, acetone, lactic acid, propionic acid, butyric acid.

Distribution of benzoic acid (H. F. Johnson and H. Bliss, Trans. Am. Inst. Chem. Engrs., 42, 337, 1946).

$C_6H_{12}O$, Pinacoline, $CH_3CO(CH_3)_3$ - Acetone (II 435).





$C_6H_{12}O$, Cyclohexanol - (See lactic acid (listed under acetic acid)).

Correction: In the table at the top of p. II 152 read "cyclohexanol" instead of "cyclohexane".

CYCLOHEXANOL - Sodium Oleate (II 435).

$C_6H_{12}O_2$, n-Caproic Acid, $CH_3(CH_2)_4COOH$. See carbon tetrachloride, acetic acid.

n-CAPROIC ACID.

Distribution between water and n- or tert-amyl alcohols, n- or sec-butanols, 2-butanone (II 440), benzene (II 438-9), chloroform (II 438), ether (II 438, 440), olive oil, petroleum ether (II 440), toluene, xylene (II 438) at low concentrations. Distribution between water and anisol, benzene, bromobenzene, carbon tetrachloride, decalin, methyl iodide, nitrobenzene, and toluene at concentrations up to 7.7 normal, which is 93. % by weight and is free of the nonaqueous solvent. (II 439). The eight systems are virtually identical and are shown in the graph.

n-CAPROIC ACID - Tetralin. (Herz and Schufton, 1922).

Distribution.

$C_6H_{12}O_2$, Isocaproic Acid, $(CH_3)_2CHCH_2CH_2COOH$.

Distribution between water and benzene, chloroform, or xylene (II 438) or olive oil (II 440) all at low concentrations.

$C_6H_{12}O_2$, 2-Ethylbutyric Acid. See acetic acid.

$C_6H_{12}O_2$, Esters, Methyl Isovalerate, Ethyl Butyrate, Propyl Propionate, Butyl Acetate, and Amyl Formate. See ethanol

For butyl acetate see also acetic acid, n-butanol, and 2,3-butene glycol.

$C_6H_{12}O_2S_4$, Ethyl Xanthic Acid.

(Halban and Hecht, Z. Elektrochem, 24, 75, 1918). Distribution between water and carbon disulfide, chloroform, amyl alcohol, petroleum ether, nitrobenzene, or benzyl alcohol.

$C_6H_{12}O_3$, Paraldehyde $(CH_3CHO)_3$.

Distribution between water and paraldehyde of acetaldehyde (II 441) and triethylamine (Timmermans, 1907). Solubility of paraldehyde in aqueous sulfuric acid (II 441), sodium salicylate, sodium benzoate, aniline hydrochloride (II 442).

$C_6H_{12}O_3$, Hydroxyisocaproic Acid $(CH_3)_2CHCH_2CHOHCOOH$.

Distribution between water and carbon tetrachloride (Int. Critical Tables (III 428).

$C_6H_{12}O_6$, Dextrose.

See acetone (II 176), and ethyl acetate (II 246, ref.).

$C_6H_{12}O_6$, Levulose. Ethyl Acetate (II 246, ref.).

$C_6H_{13}N$, Methylpiperidine, $CH_3NC_5H_{10}$.

Distribution between water and ether or xylene (II 452).

$C_6H_{13}O_2N$, Leucine and Norleucine.

Distribution between water and butyl alcohol (II 456).

C_6H_{14}, n-Hexane. See methanol, acetic acid, ethanol, acetone, isopropanol, 2-butanone, phenol, aniline.

Distribution of p-toluidine between water and n-hexane (II 558). Solubility in soap solutions, (McBain and O'Connor, 1940 and E. L. Smith, 1932).

C_6H_{14}, 2-Methylpentane. See phenol.

C_6H_{14}, 2,2-Dimethylbutane. See ethanol.

$C_6H_{14}O$, n-Hexanol. See ethanol, ethylene glycol.

Distribution of five rare earth nitrates between water and n-hexanol. (C. C. Templeton, J. Am. Chem. Soc. 71, 2187, 1949).

$C_6H_{14}O$, 2-Ethylbutanol. See acetic acid.

$C_6H_{14}O$, Isopropyl Ether $(CH_3)_2CHOCH(CH_3)_2$. See acetic acid, isopropanol.

Distribution of formic, acetic, propionic, butyric, and lactic acids (II 112). Butyric acid also on II 256.

$C_6H_{14}O_2$, Butyl Cellosolve, $CH_3(CH_2)_3OCH_2CH_2OH$. See 2-butanone (methyl ethyl ketone).

$C_6H_{14}O_6$, Mannitol, $CH_2OH(CHOH)_4CH_2OH$.

Solubility of ether (II 275), succinonitrile and triethylamine (Timmermans, 1907).

$C_6H_{15}N$, n-Hexyl Amine.

Distribution between water and xylene (II 465).

$C_6H_{15}N$, Di-n-propyl Amine. See ethanol.

Distribution between water and ether, xylene (II 465), benzene (II 466) or toluene (II 197, 466).

$C_6H_{15}N$, Triethyl Amine. See ethanol.

$BaCl_2$, KCl, K_2CO_3, K_2SO_4, KSCN, naphthalene, sucrose, mannitol, dextrose, benzil, azobenzene, camphor (Timmermans, 1907).

Distribution between water and chloroform or xylene (II 467); amyl alcohol, benzene, or toluene (II 468); ether or phenol (Meerburg, 1902).

$C_7H_3O_8N_3$, 2,4,6-Trinitrobenzoic Acid, $C_6H_2(NO_2)_3COOH$.

Distribution between water and ether (II 469).

$C_7H_4O_6N_2$, 2,4-Dinitrobenzoic Acid.

Distribution between water and chloroform, ether, or xylene (II 472).

$C_7H_4O_6N_2$, 3,5-Dinitrobenzoic Acid.

Distribution between water and chloroform (II 471-2), benzene (II 471), ether or xylene (II 472). The last system is solutropic (with a horizontal tie line).

$C_7H_5O_2Br$, o-Bromobenzoic Acid.

Distribution between water and chloroform (II 474).

$C_7H_5O_2Br$, p-Bromobenzoic Acid.-Naphthalene

(Flaschner and Rankin, 1910).

$C_7H_5O_2Cl$, o-Chlorobenzoic Acid.

Distribution between water and chloroform, ether, toluene, or xylene (II 475-6). The last is solutropic.

Correction: In the chloroform table (II 475) the last four items in the first column should be divided by ten.

$C_7H_5O_2Cl$, m-Chlorobenzoic Acid.

Distribution between water and chloroform or toluene (II 475).

$C_7H_5O_2Cl$, p-Chlorobenzoic Acid.

Distribution between water and chloroform or toluene (II 475), or naphthalene (Flaschner and Rankin, 1910).

$C_7H_5O_2I$, o-Iodobenzoic Acid.

Distribution between water and chloroform, ether, or xylene (II 478). The last is solutropic.

$C_7H_5O_2I$, p-Iodobenzoic Acid-Naphthalene.

(Flaschner and Rankin, 1910).

$C_7H_5O_2Na$, Sodium Benzoate. Ethyl Acetate (II 247), Ether (II 275), Isoamyl Alcohol (II 315), Aniline (II 410), Phenol (Schryver, 1910, Euler and Suanberg, 1917).

$C_7H_5O_3Na$, Sodium Salicylate. Same and also Olive Oil (I 1178).

$C_7H_5O_3Na$, Sodium-p-Hydroxybenzoate - Isoamyl Alcohol (II 315).

$C_7H_5O_3S$, Saccharine, $C_6H_4\begin{matrix}SO_2\\CO\end{matrix}NH$. Ether and Amyl Acetate (II 478).

$C_7H_5NO_3$ - o-, m-, and p-Nitrobenzoic Acids.

Distribution between water and chloroform, ether, benzene, toluene, or xylene (II 486-91). Three of these combinations are solutropic. The para isomer is distributed between water and benzophenone (Flaschner and Rankin, 1910).

C_7H_6O, Benzaldehyde. See acetic acid, ethanol, and dioxane.

$C_7H_6O_2$, Benzoic Acid.

Distribution between water and fifteen solvents (II 509-13). Toluene F. J. Appel and J. C. Elgin, Ind. Eng. Chem., 29, 451 (1937); S. B. Row, J. H. Hoffolt, and J. R. Withrow, Trans. Am. Inst. Chem. Engrs., 37, 571 (1941). See also carbon tetrachloride, benzene, pyridine, and methyl isobutyl ketone.

$C_7H_6O_3$, Salicylic Acid. Phenol (II 383-4, 389, 524) and seven other solvents (II 523-5, 527).

$C_7H_6O_3$, m- and p-Hydroxybenzoic Acids.

Distribution between water and ether or olive oil (II 529-30). Correction: In the lower table of II 529 "(Liquid)" applies only to the temperature 197.0°.

$C_7H_6O_4$, Dihydroxybenzoic Acids. 2,4-(Resorcylic), 2,5-(Gentisic), and 3,4- with four solvents (II 531, 533).

$C_7H_6O_5$, Gallic Acid (3,4,5-Trihydroxybenzoic Acid).

Distribution between water and ether or olive oil (II 533).

C_7H_7Br, o-Bromotoluene. See ethanol and n-propanol.

C_7H_7Br, p-Bromotoluene. See acetic acid.

C_7H_7ON, Benzamide $C_6H_5CONH_2$.

Distribution between water and oil (II 535), cod liver oil, (Int. Critical Tables III 430).

$C_7H_7O_2N$, Salicylamide.

Distribution between water and olive oil (II 541) or cod liver oil (Int. Critical Tables III 430).

$C_7H_7O_2N$, o-Nitrotoluene. See methanol, ethanol, and formic, acetic, propionic, and mono-, di-, and trichloroacetic acids.

$C_7H_7NO_2$, Anthranilic Acid, $NH_2C_6H_4COOH$ (o-).

Distribution between water and chloroform, ether, or benzene (II 540). Correction: The heading of the third table should be "Glycerol and Acetone".

ANTHRANILIC ACID - Pyridine.

(E. F. Zhuravlev, J. Gen. Chem. (U.S.S.R.) 8, 1704, 1938). The system has a ternary critical solution point at 105°.

$C_7H_7NO_2$, m- and p-Aminobenzoic Acids. Benzophenone, Naphthalene, Benzil, and Camphor (Flaschner and Rankin, 1910).

In their table for the binary systems with water on p II 539 the "crit. sol. temp" at 66° and 47° are metastable, being "submerged" below the freezing curve, and occur at 40% acid. There is a similar submerged critical solution point for the ortho acid at 78° and 38%.

C_7H_8, TOLUENE. See acetaldehyde, acetic acid, acetone, aniline, n-butyric acid, caproic acid, chloroacetic acid, diethyl amine, ethanol, formic acid, furfural, methanol, phenol, n- and isopropanols, propionic acid, pyridine, trichloroacetic acid, triethyl amine, isovaleric acid, benzoic acid, n-butanol.

TOLUENE - $AgClO_4$ (I 53); $HgCl_2$ (I 632); Iodine (I 655).

Distribution between water and toluene (pages in Seidell, Vol. II).

Acids

Acetic 111-2
Acetylsalicylic 631
Benzoic 511-2
Benzilic 749
Bromoacetic 86
α-Bromobutyric 238
α- and β-Bromopropionic 170
α-Bromovaleric 295
α-Bromoisovaleric 295
n- and Isobutyric 252-3, 256
Caproic 438-9
Chloroacetic 89, 90
o-, m-, and p-Chlorobenzoic 475
β Chloropropionic 171
Cinnamic 627
Crotonic 222
Dichloroacetic 78
Formic 30
β-Iodopropionic 172
α and β-Methoxy benzoic 591-2
Methylanthranilic 606
m- and p-Nitrobenzoic 487
Phenylacetic 583
Picric 330-1
Propionic 190
Salicylic 524
o- and p-Toluic 587
Trichloroacetic 69
n- and Isovaleric 302-3, 306

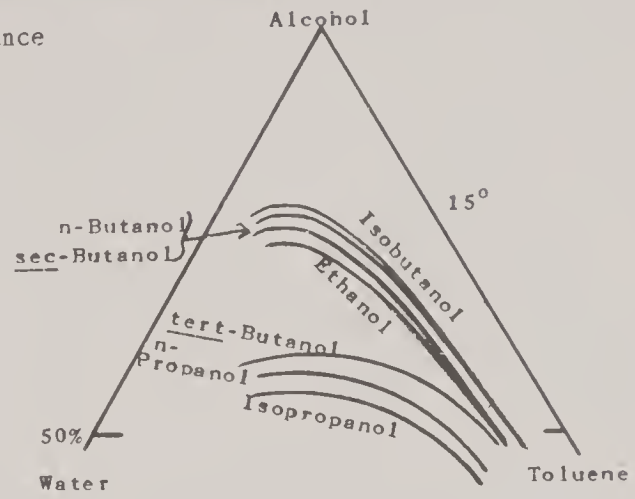
Other Compounds

Chloral Hydrate 93
Collidine 616
Dimethyl Amine 160
Dipropyl Amine 197, 466
Ethyl Amine 162
Methyl Amine 65
n-Propyl Amine 197
Triethyl Amine 468
Trimethyl Amine 211-2
Tripropyl Amine 197

TERNARY AQUEOUS SYSTEMS

TOLUENE - Alcohols (Ormandy, Pond, and Davies, (1934).

Many data on water tolerance of alcohol-toluene mixture.



TOLUENE - Solubility in aqueous solutions of KOH and phenols: m-Cresol (II 550), Xylenol (II 607), Carvacrol (II 675).

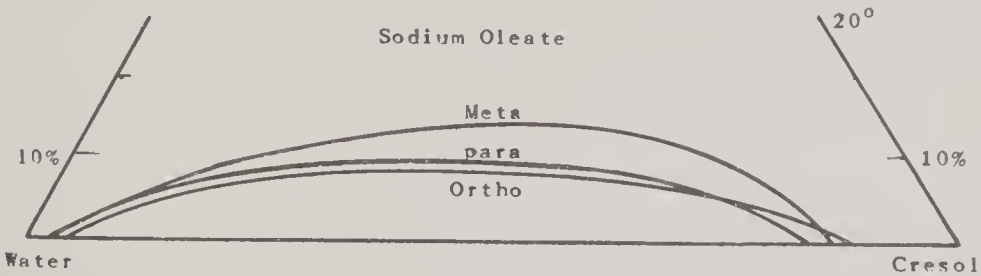
TOLUENE - Solubility in aqueous sodium oleate (E. L. Smith, 1932).

C_7H_8O, o-Cresol, $CH_3C_5H_4OH$. See ethanol, methanol, phenol.

CRESOLS - Xylenols $(CH_3)_2C_6H_3OH$.

Paris and Vial (1948) observed effects of three xylenols on solution temperatures of definite concentrations of all three cresols in water.

THREE CRESOLS - Sodium Oleate (I 1188, II 548)



C_7H_8O, m-Cresol. See benzene, ether, o-cresol, phenol, toluene.

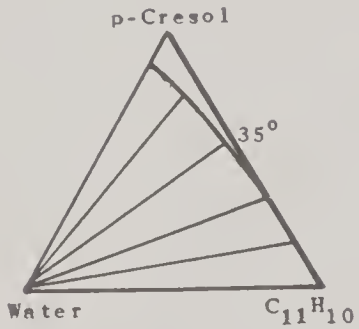
m-CRESOL - Solubility in aqueous solutions of HCl, H_2SO_4, NaCl, $NaSO_4$, $MgCl_2$ (not $MgCl_4$), $MgSO_4$, Na_3PO_4, H_3PO_4 (II 548).

m-CRESOL - n-Heptane, Toluene, sec. Octyl Alcohol (II 550).

C_7H_8O, p-Cresol. See o-cresol, methanol, phenol.

p-CRESOL - $C_{11}H_{10}$. α-Methylnaphthalene (Prutton, Walsh, and Desai, 1950).

Compositions in gms. per 100 gms. saturated solution.



Upper Layer ($C_{11}H_{10}$ negligible)		Lower Layer		
Water	p-Cresol	Water	p-Cresol	$C_{11}H_{10}$
100	0.0	0.0	0.0	100.0
98.8	1.2	0.8	18.8	80.4
98.6	1.4	2.0	34.5	63.5
98.0	2.0	4.3	53.4	42.3
97.6	2.4	10.2	74.1	15.7
97.3	2.7	13.6	86.4	0.0

C_7H_8O, Benzyl Alcohol, $C_6H_5CH_2OH$. See ethanol, ethyl xanthic acid, ($C_5H_{12}O_2S_4$), glycerol, lactic acid (under acetic acid), trichloroacetic acid.

C_7H_8O, Anisol, $C_6H_5OCH_3$. See acetic acid, benzoic acid, caproic acid.

$C_7H_8ON_2$, p-Nitrosomethyl aniline. $NOC_6H_4NHCH_3$. See benzene

$C_7H_8O_2N_4$, Theobromine and Theophylline.

Distribution between water and olive oil (II 552).

C_7H_9N, o-Toluidine, $CH_3C_6H_4NH_2$. See acetic acid, benzene, ethanol, lactic acid, methanol, propionic acid, isopropanol.

C_7H_9N, m-Toluidine. See acetic acid, benzene, butyric acid, methanol, propionic acid.

C_7H_9N, p-Toluidine, See carbon tetrachloride (II 557), benzene, hexane (II 558).

Solubility in sodium oleate (II 558).

C_7H_9N, Benzyl Amine, $C_6H_5CH_2NH_2$.

Distribution between water and benzene, chloroform, ether, heptane, or xylene (II 554).

C_7H_9N, Methylaniline, $C_6H_5NHCH_3$. See ethanol and xylene.

C_7H_9ON, p-Anisidine, $CH_3OC_6H_4NH_2$. See benzene (II 560).

$C_7H_9O_2N$, Ammonium Benzoate. See aniline, nitrobenzene.

$C_7H_{12}O$, Methylcyclohexanone. See acetic acid.

$C_7H_{12}O_4$, Pimelic Acid - Distribution between water and ether (II 561).

$C_7H_{12}O_5$, Diacetin, $C_3H_5(OH)(OCOCH_3)_2$. Distribution between water and olive oil (II 307).

$C_7H_{13}O_2N$, Sodium Caproate - Distribution between water and phenol (I 1173).

C_7H_{14}, Methylcyclohexane. See aniline, ethanol, phenol.

$C_7H_{14}O$, Methyl-n-Amyl Ketone. See acetic acid, ethylene glycol.

$C_7H_{14}O$, Di-n-Propyl Ketone. See ethanol.

$C_7H_{14}O$, Three Methylcyclohexanols. See methanol.

$C_7H_{14}O_2$, Heptylic Acid. See carbon tetrachloride.

Distribution between water and olive oil (II 566).

$C_7H_{14}O$, Isoamylacetic Acid.

Distribution between water and xylene (II 566).

$C_7H_{14}O_2$, Ethyl n- and Isovalerates. See ethanol.

$C_7H_{14}O_2$, Propyl Butyrate. See ethanol.

$C_7H_{14}O_2$, Amyl Acetate. See acetic acid, ethanol.

$C_7H_{14}O_2$, Isoamyl Acetate. See acetic acid, ethanol, and furfural.

$C_7H_{14}O_3$, n- and Isobutyl Lactates. See acetic acid.

$C_7H_{15}ON$, Ethyl Valeramide, Dimethyl Valeramide.

Distribution between water and olive oil (Int. Critical Tables III 430).

$C_7H_{15}O_2N$, Diethyllactamide, $(C_2H_5)_2CHCHOHCONH_2$. Ibid.

$C_7H_{15}O_2N$. Isobutyl Urethane.

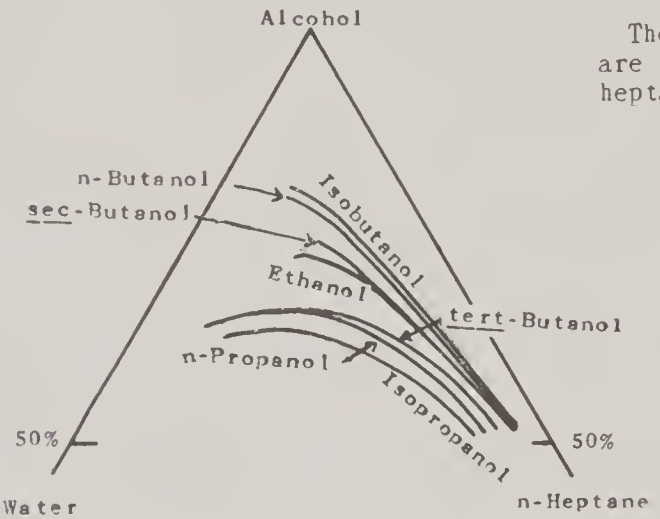
Distribution between water and cod liver oil. (Int. Critical Tables III 430). This may be isobutyl carbamate $C_5H_{11}O_2N$. cf. note under $C_2H_5O_2N$.

C_7H_{16}. n-Heptane. See acetone, aniline, chloroaniline, m-cresol, ethanol, methanol, methyl ethyl ketone, o-nitroaniline, phenol.

n-HEPTANE.

Solubility in aqueous solutions of KOH and carvacrol (II 675).

n-HEPTANE - Alcohols (Ormandy, Pond, and Davies, 1934).



The numerous numerical data are in water tolerance of n-heptane-alcohol mixtures.

GASOLINE. See acetic acid, acetic anhydride, acetone, benzene, benzoic acid, ethanol, ether, ethyl acetate, isopropanol, methanol, methyl ethyl ketone, phenol.

GASOLINE - Alcohols.

(Ormandy, Pond, and Davies, 1934). Data very similar to those for n-heptane with the same alcohols and also active amyl alcohol and octyl alcohol.

GASOLINE.- Effect of soap on solubility in water. (E. L. Smith, 1932) (McBain and O'Connor, 1940).

$C_7H_{16}O$. Diisopropyl Carbinol. See acetic acid.

$C_7H_{16}O_4S_2$. Sulfonal. $(CH_3)_2C(SO_2C_2H_5)_2$. Olive Oil (II 317).

$C_7H_{17}N$, n-Heptyl Amine.

Distribution between water and ether or xylene (II 569).

$C_8H_4O_4Na_2$, Sodium Phthalate. Ether (II 275).

$C_8H_6O_4$, o-, m-, and p-Phthalic Acids, $C_6H_4(COOH)_2$.

Distribution between water and ether, xylene, or olive oil (II 574).

$C_8H_6O_4$, Piperonylic Acid, $\underbrace{OCH_2O}C_6H_3COOH$.

Distribution between water and chloroform or xylene (II 572). The latter system is solutropic.

C_8H_8, Styrene, $C_6H_5CH{:}CH_2$. See methanol, acrylonitrile.

C_8H_8O, Acetophenone, $C_6H_5COCH_3$. See lactic acid (listed under acetic acid).

$C_8H_8O_2$, Phenylacetic Acid.

Solubility in aqueous hydrochloric and sulfuric acids (II 582).

Distribution between water and benzene, chloroform, ether, isoamyl alcohol, nitrobenzene, toluene, or xylene (II 582-3). The toluene system is solutropic.

$C_8H_8O_2$, o- and p-Toluic Acid, $CH_3C_6H_4COOH$.

Distribution between water and chloroform or toluene (II 587).

$C_8H_8O_2$, Methyl Benzoate. See methanol.

$C_8H_8O_3$, Methyl Salicylate. See ethanol.

$C_8H_8O_3$, Mandelic Acid, $C_6H_5CHOHCOOH$.

Distribution between water and anisole, benzene, chloroform, or ether (II 594-6).

$C_8H_8O_3$, Vanillin, $C_6H_3(CHO)OCH_3{\cdot}OH$ (1,3,4).

Distribution between water and ether (II 589).

$C_8H_8O_3$, o-Methoxybenzoic Acid.

Distribution between water and chloroform or toluene (II 591). Correction: In the toluene table (II 591) under "H_2O layer" the last item should be 0.0178.

$C_8H_8O_3$, Anisic Acid, p-Methoxybenzoic Acid.

Distribution between water and chloroform, olive oil, toluene, or xylene (II 591-2). The xylene system is solutropic. In the table of Flaschner and Rankin (II 591) the item 138.2° is a critical solution temperature at 40% anisic acid. It is submerged below the freezing curve indicated by the other points.

$C_8H_8O_4$, Guaiacyl Acid Carbonate.

Distribution between water and olive oil. (Int. Critical Tables III 431).

C_8H_9ON, Acetanilide, $C_6H_5NHCOCH_3$.

Distribution between water and benzene, chloroform, or ether (II 605).

$C_8H_9O_2N$, Methylanthranilic Acid, $CH_3NHC_6H_4COOH$.

Distribution between water and chloroform or toluene (II 606).

$C_8H_9O_3SNa$, Sodium Xylene Sulfonate. Aniline (II 407).

C_8H_{10}, o-Xylene. See acetic acid, acetone, benzoic acid, ethanol, ethylene glycol, methanol.

C_8H_{10}, m-Xylene. See acetic acid, acetone, aniline, butyric acid, diethyl amine, ethanol, formic acid, methanol, phenol, n- and isopropanol, propionic acid, pyridine, trimethyl amine.

C_8H_{10}, p-Xylene. See acetic acid, ethanol, methanol.

Distributions between water and xylene. (Pages in Seidell II)

Acids

Acetic	112	Chlorobenzoic	476(s)	m-Nitrobenzoic	486(s)
Acetylsalicylic	630	Cinnamic	627	p-Nitrobenzoic	487
Anisic	592	Crotonic	221	Phenylacetic	583(s)
Benzoic	510, 512	Dibromopropionic	165	Phenylpropionic	634
Benzilic	749	2,4 and 3,5-Dinitrobenzoic	472	o-Phthalic	574(s)
Bromoacetic	86	Gentisic	531	Piperonylic	572(s)
Bromopropionic	170	Isoamylacetic	566	Propionic	191
Bromosuccinic	219	Iodobenzoic	478(s)	Pyruvic	166
n- and Isobutyric	252	Iodopropionic	172	Resorcylic	531(s)
Camphoric	681	Levulinic	293	Salicylic	524(s)
n- and Isocaproic	438	Formic	30	Valeric	301
				Isovaleric	303, 305

(s) Solutropic system.

Distributions between water and xylene (Cont.) (pages in Seidell II)

Other Solutes

Allyl Amine	198	Ethyl Phenyl Amine	467
n- and Isoamyl Amine	317	n-Heptyl Amine	569
n- and Isobutyl Amine	280	n- Hexyl Amine	465
Benzyl Amine	554	Methyl Amine	64
Benzyl Ethyl Amine	642	Methylaniline	416
Benzyl Methyl Amine	616	Methylpiperidine	452
Bornyl Amine	683	Phenol	386
Camphyl Amine	684	Piperidine	308
Coniine	621	n-Propyl Amine	213
Diethyl Amine	278	Pyridine	288
Dimethyl Amine	160	Quinoline	624
Di-n-Propyl Amine	465	Triethyl Amine	467
Dimethylaniline	ICT 431[a]	Trimethyl Amine	211-2
Ethyl Amine	161	2,4- and 2,5-Xylidine	615

(a) Int. Critical Tables III.

C_8H_{10}. Ethylbenzene.

Distribution of diethyl amine (II 280), trimethyl amine (II 212).

$C_8H_{10}O$, Phenylethanol, $C_6H_5CH_2CH_2OH$.

Distribution of lactic acid (listed under acetic acid).

$C_8H_{10}O$, Phenetole, $C_6H_5OCH_2CH_3$.

See acetic acid, ethancl. Distribution of benzoic acid (II 512).

$C_8H_{10}O$, Xylenol.

See toluene, cresols. Distribution between water and sec-Octyl alcohol (II 607).

$C_8H_{10}ON_2$, p-Nitrosodimethylaniline. See benzene.

$C_8H_{10}O_2$, Phenyl Cellosolve, $C_6H_5OCH_2CH_2OH$.

Distribution of acetic and lactic acids (listed under acetic acid).

$C_8H_{10}O_2N_4$. Caffeine.

Distribution between water and chloroform or olive oil (II 612-3), ether or sesame oil (Int. Critical Tables III 431).

$C_8H_{11}N$, Ethylaniline, $C_6H_5NHC_2H_5$.

Distribution between water and xylene (II 467).

$C_8H_{11}N$, Benzyl Methyl Amine, $C_6H_5CH_2NHCH_3$.

Distribution between water and ether or xylene (II 616).

$C_8H_{11}N$, Dimethylaniline, $C_6H_5N(CH_3)_2$.

Distribution between water and xylene (Int. Crit. Tables III 431).

$C_8H_{11}N$, 2,4- and 2,5-Xylidine. See methanol.

Distribution between water and xylene (II 615).

$C_8H_{11}N$, Collidine (2,4,6-Trimethylpyridine).

Distribution between water and toluene (II 616).

$C_8H_{12}O_3N_2$, Veronal (Diethylbarbituric acid) $CO(NHCO)_2C(C_2H_5)_2$.

Distribution between water and olive oil (II 203).

$C_8H_{14}O_2$, Cyclohexyl Acetate, $C_6H_{11}OCOCH_3$. See acetic acid.

$C_8H_{14}O_4$, 2,3 Butene Diacetate $(CH_3\dot{C}HOCOCH_3)_2$. See 2,3-butene glycol.

$C_8H_{14}O_4$, Suberic Acid, $(CH_2CH_2CH_2COOH)_2$.

Distribution between water and ether (II 618).

$C_8H_{14}O_6$, Diethyl Tartrate $(CHOHCOOC_2H_5)_2$.

Distribution between water and ether (II 619), benzene or ethylene bromide (Int. Critical Tables III 431).

C_8H_{16}, Diisobutene, $(CH_3)_3CCH{:}C(CH_3)_2$ and $(CH_3)_3C{\cdot}CH_2C(CH_3){:}CH_2$. See ethanol.

C_8H_{16}, Dimethylcyclohexane (Hexahydroxylene).

Solubility in 92% ethanol (II 607).

$C_8H_{16}O_2$, n-Caprylic Acid, $CH_3(CH_2)_6COOH$.

Distribution between water and petroleum ether (II 619) or olive oil (II 620).

$C_8H_{16}O_2$, 2-Ethylhexoic Acid. See acetic acid.

$C_8H_{16}O_3$, Amyl Lactate, $C_5H_{11}OCOCHOHCH_3$. See acetic and lactic acids.

$C_8H_{16}O_3$, Butyl Cellosolve Acetate, $C_4H_9OCH_2CH_2OCOCH_3$.

Distribution of lactic acid (listed under acetic acid).

$C_8H_{17}N$, Coniine (α-Propylpiperidine).

Distribution between ether and xylene (II 621).

C_8H_{18}, 2,2,4-Trimethylpentane (Isooctane). See ethanol and 2-butanone (methyl ethyl ketone).

$C_8H_{18}O$, n-Octyl Alcohol. See acetic acid.

$C_8H_{18}O$, sec-Octyl Alcohol. See acetic acid, gasoline.

Distribution of diethyl amine (II 279), phenol (II 379), m-cresol (II 550), 2,4-xylenol (II 607),carvacrol (II 675). Correction: Instead of "normal" read "straight chain" (II 379, 550, 607, 675).

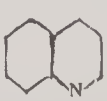
$C_8H_{18}O$, 2-Ethylhexanol. See acetic acid.

$C_8H_{18}O$, Di-n-butyl Ether. See acetic acid, acetone, ethanol, n-butanol.

Distribution of diethyl amine (II 279), chloroacetic acid (II 92), dichloroacetic acid (II 79).

$C_8H_{18}O_4S_2$,Trional, $C_2H_5(CH_3)C(SO_2C_2H_5)_2$.

Distribution between water and olive oil (II 317). Solubility in 90% ethanol (II 568).

C_9H_7N, Quinoline. 

Distribution between water and xylene (II 624).

C_9H_7ON, β-Hydroxyquinoline.

Distribution between water and benzene (Int. Critical Tables III 431).

$C_9H_7O_2Na$, Sodium Cinnamate. Salting out of ether (II 275) and isoamyl alcohol (II 315).

$C_9H_8O_2$, Cinnamic Acid, $C_6H_5CH{:}CHCOOH$.

Distribution between water and chloroform, toluene, or xylene (II 627).

$C_9H_8O_3NNa$, Sodium Hippurate. Salting out of isoamyl alcohol (II 315).

$C_9H_8O_4$, Aspirin (acetylsalicylic acid) $C_6H_4(COOH)OCOCH_3$.

Distribution between water and chloroform, ether, toluene, or xylene (II 630-1).

$C_9H_8O_4$, Homophthalic Acid, $COOHC_6H_4CH_2COOH$ (1,2-).

Distribution between water and ether (Dieckmann and Hardt, 1919).

$C_9H_9O_3N$, Hiopuric Acid.

Distribution between water and ether (II 633).

$C_9H_{10}O_2$, Phenylpropionic Acid.

Distribution between water and chloroform or xylene (II 634).

$C_9H_{10}O_2$, Benzyl Acetate. See ethanol.

$C_9H_{11}ON$, Acetyl-o-toluidine.

Distribution between water and benzene. Farmer and Warth (1904).

$C_9H_{11}O_2N$, N-Phenylurethane, $C_6H_5NHCOOC_2H_5$.

Distribution between water and olive oil (Int. Critical Tables III 431).

C_9H_{12}, Cumene (Isopropylbenzene).

Distribution of trichloroacetic acid (II 69).

C_9H_{12}, Mesitylene, $C_6H_3(CH_3)_3$ (1,3,5-). See methanol, ethanol.

$C_9H_{12}O$, Benzyl Ethyl Ether, $C_6H_5CH_2OC_2H_5$. See ethanol.

$C_9H_{13}N$, Benzyl Ethyl Amine, $C_6H_5CH_2NHC_2H_5$.

Distribution between water and ether or xylene (II 642).

$C_9H_{14}O$, Phoron $(CH_3)_2C{:}CHCOCH{:}C(CH_3)_2$.

Distribution of lactic acid (listed under acetic acid).

$C_9H_{14}O$, Isophoron, $CH_3C{:}CHCOCH_2C(CH_3)_2CH_2$. See acetic acid.

$C_9H_{14}O_6$, Triacetin, $C_3H_5(OCOCH_3)_3$. See acetic acid.

Distribution between water and olive oil (II 307).

$C_9H_{16}O_4$, Azelaic Acid, $COOH(CH_2)_2COOH$.

Distribution between water and ether (II 643).

$C_9H_{17}NO_3$, Detonal, $(C_2H_5)_2CHCONHCOOC_2H_5$ - Olive Oil (II 203).

$C_9H_{18}O$, Diisobutyl Ketone $[(CH_3)_2CHCH_2]_2CO$. See acetic acid

$C_9H_{18}O_2$, Pelargonic Acid, $CH_3(CH_2)_7COOH$ - Olive Oil (II 644).

$C_9H_{19}ON$, Diethylvaleramide, $CH_3(CH_2)_3CON(C_2H_5)_2$ - Olive Oil. Int. Critical Tables III 432.

C_9H_{20}, n-Nonane - Diethyl Amine (II 279).

$C_9H_{20}O_4S_2$, Tetronal - Olive Oil (II 317).

$C_9H_{21}N$, Tripropyl Amine $(CH_3CH_2CH_2)_3N$ - Toluene (II 197).

$C_{10}H_7Br$, Bromonaphthalene. See ethanol.

$C_{10}H_7O_2N$, α-Nitronaphthalene. Ethanol (II 647). Two liquids between 25.5° and 44.1°.

$C_{10}H_8$, Naphthalene. See acetone, p-amino-, p-bromo, p-chloro, p-iodobenzoic acids, tert-butanol, butyric acid, phenol, succinonitrile, triethyl amine.

$C_{10}H_8O$, β-Naphthol.

Distribution between water and chloroform or benzene (II 660).

$C_{10}H_8O_3NaS$, Sodium Naphthionate. See isoamyl alcohol.

$C_{10}H_9N$, α and β-Naphthyl Amine. See benzene and phenol.

$C_{10}H_{11}O_3N$, p-Acetoxyacetanilide.

Distribution between water and chloroform (II 668).

$C_{10}H_{12}$, Tetralin or Tetrahydronaphthalene. See iodine, acetic, caproic and picric acids. Distribution of mercuric chloride (Herz and Shaffton, 1922)

$C_{10}H_{12}O$, Anethole, p-Propenylanisole. See ethanol and acetone.

$C_{10}H_{12}O_2$, Eugenol, $CH_2:CHCH_2C_6H_3(OH)OCH_3(1,4,3-)$. See ethanol and lactic acid.

$C_{10}H_{12}O_2$, Isoeugenol, $CH_3CH:CHC_6H_3(OH)OCH_3$ (1,4,3-). See acetic acid.

Other animal and vegetable oils with acetic acid (II 830) and ethanol (II 832, and Int. Crit. Tables III 401).

$C_{10}H_{13}SO_3Na$, Sodium Cymene Sulfonate. See aniline.

$C_{10}H_{14}$, Cymene. See acetic and lactic acids.

$C_{10}H_{14}N_2$, Nicotine. See trichloroethylene.

Nicotine. Effect of NaOH, Na_2SO_4, HCl on solubility in water (Int. Crit. Tables III 409). Sesame oil (ibid. 432).

Nicotine. Distribution between water and kerosene or lubricating oil. (L. B. Norton, Ind. Eng. Chem. 32, 241, 1940). Concentrations in gms. per l.

Water	Kerosene	c/c'	Water	Lub. Oil	c/c'
0.565	0.479	1.18	0.264	0.241	1.1
5.25	4.3	1.13	2.55	2.32	1.1
25.6	18.6	1.38	17.9	14.7	1.22
69.7	37.3	1.87	68.1	31.9	2.13
130	57.6	2.26	112.1	40.4	2.77
267	61.4	4.35	206.1	47.4	4.35
469	77.0	6.09	492	70.5	6.98
702	115	6.10	709	107	6.63
834	227	3.68	877	311	2.82

Effects of HCl, H_2SO_4, AcOH, NaOH, $Ca(OH)_2$ on distribution ratio were observed. Above 0.1 normality acids raised the ratio and bases decreased it.

Additional data on systems of nicotine, water, and petroleum fractions are given by Holmes (1918) and by Claffey and coworkers (Ind. Eng. Chem. 42, 167, 1950).

$C_{10}H_{14}O$, Thymol, 3-Methyl-6-Isopropylphenol. See phenol.

Distribution between water and seven oils (II 674-5).

$C_{10}H_{14}O$, Carvacrol, 2-Methyl-5-Isopropylphenol.

Distribution between water and toluene, heptane, or sec-octyl alcohol (II 675).

$C_{10}H_{14}O_3N_4$ - Ethoxycaffeine - Olive Oil (II 613).

$C_{10}H_{16}$, Pinene. See ethanol and lactic acid.

$C_{10}H_{16}$, Turpentine. See ethanol.

$C_{10}H_{16}$, Limonene. See lactic acid.

$C_{10}H_{16}O$, Camphor. See m- and p-aminobenzoic acid, n-butyric acid, succinonitrile, phenol and triethyl amine (II 389)

$C_{10}H_{16}O$, Fenchone. See acetic acid.

$C_{10}H_{16}O_4$, Camohoric Acid.

Distribution between water and chloroform or xylene (II 681), or ether (II 681, ref. and Dieckmann and Hardt, 1919).

$C_{10}H_{18}$, Decalin.

Distribution of iodine and acetic acid (Int. Crit. Tables III 420), Herz and Schuftan (1922), propionic acid (II 191), caproic acid (II 439).

$C_{10}H_{18}O$, Terpineol. See acetic and lactic acids.

$C_{10}H_{18}O_4$, Sebacic Acid $(CH_2)_8(COOH)_2$.

Distribution between water and ether (II 683).

$C_{10}H_{19}N$, Bornyl Amine and Camohyl Amine.

Distribution between water and xylene (II 683-4)

$C_{10}H_{19}O_3N$, Bronal.

Distribution between water and olive oil (II 203).

$C_{10}H_{20}O_2$, Octyl Acetate and Butyl Diacetone Ether. See acetic acid.

$C_{10}H_{20}O_4$, Butyl Carbitol Acetate. See acetic and lactic acids.

$C_{10}H_{22}$, Decanes or Paraffin Oil (b.p. 160-180°). Diethyl Amine (II 279); Ethanol (II 152).

$C_{10}H_{22}O$, n-Amyl Ether. See acetic and lactic acids.

$C_{10}H_{22}O$, Isoamyl Ether. See ethanol, succinic, and benzoic acids.

$C_{11}H_{10}$, α-Methylnaphthalene. See methanol, phenol, and p-cresol.

$C_{11}H_{12}ON_2$, Antipyrine.

Distribution between water and chloroform (II 687).

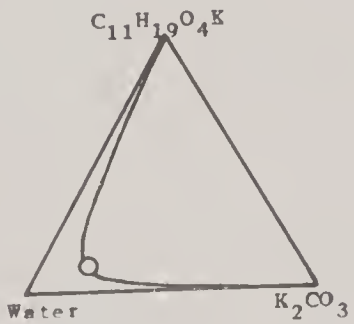
$C_{11}H_{16}$, Butyltoluene. See methanol, ethanol, and isopropanol.

$C_{11}H_{16}O$, Isoamyl Phenyl Ether.

Distribution of diethyl amine (II 279).

$C_{11}H_{16}O_2N_2$, Pilocarvine - Sesame Oil (Wamossy, 1913).

$C_{11}H_{19}O_4K$, Potassium Ethyl Dipropylmalonate -K_2CO_3 (I 737).



$C_{11}H_{22}O$, Amylcyclohexanol. See lactic acid (listed under acetic acid).

$C_{12}H_{10}N_2$, Azobenzene, $C_6H_5N{:}NC_6H_5$. See phenol and triethylamine.

$C_{12}H_{10}O_2$, Diphenyl Oxide. See ethanol.

$C_{12}H_{10}ON_2$, Hydroxyazobenzene.

Distribution between water and benzene (II 700).

$C_{12}H_{11}N_3$, Aminoazobenzene.

Distribution between water and benzene (II 705).

$C_{12}H_{12}O_5$, Keto-y-Phenyladipic Acid. $HOOCCOCH_2CH(C_6H_5)CH_2COOH$. See ether.

$C_{12}H_{22}O_{11}$, Lactose. Effect on water solubility of ethyl acetate (II 246).

$C_{12}H_{22}O_{11}$, Sucrose. See acetone (II 175, 714), ethyl acetate (II 246), and butyric acid (II 258).

$C_{12}H_{22}O_{11}$, Maltose. See acetone (II 175).

$C_{12}H_{23}O_2K$, Potassium Laurate - $C_{12}H_{24}O_2$. Lauric Acid.

(J. W. McBain and H. C. Field, J. Am. Chem. Soc., 55, 4776, 1933). Many complex isotherms at 25 to 370° were presented.

KEROSENE. See acetic acid, aniline, ethanol, formic acid, iodine, methanol, nicotine, nitrobenzene, and phenol.

$C_{13}H_9N$, Acridine, $C_5H_4{<}^{CH}_{N}{>}C_5H_4$, and 17 derivatives.

Distribution between water and olive oil (A. Albert, R. Goldacre, and E. Heymann, J. Chem. Soc., 1943, 651). The coefficients vary from < 0.2 for euflavine to 1200 for 1-aminoacridine. For acridine it is 200 (times as concentrated in olive oil as in water).

$C_{13}H_{10}O$, Benzophenone, $(C_5H_5)_2CO$. See acetone (II 176), ethanol (II 722), butyric (II 258), m- and p-aminobenzoic acid, and p-nitrobenzoic acid.(Flaschner and Rankin, 1910)

$C_{13}H_{10}O_3$, Salol. See phenol (II 373).

$C_{13}H_{20}O_2N_2$, Novocaine.

Distribution between water and ether (II 729) and sesame oil (Wamossy, 1913).

$C_{14}H_8O_2$, Anthraquinone, $C_6H_4{<}^{CO}_{CO}{>}C_6H_4$. See phenol (II 373, 732).

$C_{14}H_{10}O_2$, Benzil $(C_5H_5CO)_2$ - Phenol, Succinonitrile, and Triethyl Amine (II 745). See p-aminobenzoic acid.

$C_{14}H_{12}O_3$, Benzilic Acid, $(C_6H_5)_2C(OH)COOH$.

Distribution between water and chloroform, ether, toluene, or xylene (II 749).

$C_{15}H_{22}O_2NCl$, β-Eucaine Hydrochloride - Sesame Oil (Wamossy, 1913).

$C_{16}H_{18}N_3SCl$, Methylene Blue.

Distribution between water and aniline (II 762, ref.).

$C_{15}H_{26}O_2N_2$, Pantocaine.

Distribution between water and ether (II 729).

$C_{17}H_{19}O_3N$, Morphine.

Distribution between water and chloroform or sesame oil (Int. Crit. Tables III 432).

$C_{17}H_{21}O_4N$, Cocaine - Sesame Oil (Wamossy, 1913).

$C_{17}H_{22}NBr$, Methyl Propyl Phenyl Benzylammonium Bromide.

Distribution between water and chloroform (Int. Crit. Tables III 432).

$C_{17}H_{23}O_3N$, Atropin.

Distribution between water and chloroform (II 778) or sesame oil (Wamossy, 1913).

$C_{18}H_{18}O_2$, Hexamethyl Mellitate-Phenol (II 781).

$C_{18}H_{21}O_3N$, Codeine.

Distribution between water and chloroform, ether, or sesame oil (Int. Crit. Tables III 432).

$C_{18}H_{33}O_2K$, Potassium Oleate.

Effect on solubilities of propylene, isobutane, butadiene, n-hexane, methylcyclopentane (McBain and O'Connor, 1940).

$C_{18}H_{33}O_2Na$, Sodium Oleate.

Effect on solubilities of aniline (II 407), anisole (II 546), benzaldehyde (II 497), benzene, toluene, and xylene (E. L. Smith, 1932), cresols (I 1188), cyclohexanol (II 435), ethyl acetate (II 247), isoamyl alcohol (II 315), nitrobenzene (II 357), phenol (I 1188, II 377, 389), p-toluidine (II 558).

$C_{18}H_{34}O_2$, Oleic Acid. See ethanol.

$C_{19}H_{24}O_3ClN \cdot 2Aq$, Dionine-Sesame Oil (Wamossy, 1913).

$C_{20}H_{14}O_{14}$, Phenolphthalein.

Distribution between water and benzene (Int. Crit. Tables III 432).

$C_{20}H_{20}ClN_3$, Fuchsin.

Distribution between water and isobutanol (Int. Crit. Tables (III 432).

$C_{22}H_{24}ClN_3$, New Fuchsin (Ibid.).

$C_{20}H_{24}O_2N_2 \cdot 3Aq$, Quinine.

Distribution between water and chloroform (Int. Crit. Tables III 432), ether (II 803) or sesame oil (Wamossy, 1913).

$C_{20}H_{24}O_2N_2(Bi\ I_3)$, 2HI, Quinine Iodobismuthate. See acetone (I 202, II 808).

$C_{21}H_{22}O_2N_2$, Strychnine.

Distribution between water and chloroform (II 813), or sesame oil (Wamossy, 1913).

$C_{21}H_{23}O_5N_3$, Strychnine Nitrate.

Distribution between water and chloroform (II 815).

STRYCHNINE SULFATE.

Distribution between water and chloroform (Int. Crit. Tables III 433).

$C_{22}H_{23}O_7N$, Narcotine-Sesame Oil (Wamossy, 1913).

$C_{22}H_{24}NBr$ and $C_{22}H_{24}NCl$, Methyl Tribenzyl-Ammonium Bromide and Chloride.

Distribution between water and bromoform or chloroform. K. Drucker, Z. Elektrochem, 18, 562, 1912).

$C_{23}H_{26}O_4N_2$, Brucine and $C_{22}H_{25}O_6N$, Colchicine-Sesame Oil (Wamossy, 1913).

PARAFFIN OIL. See methanol, n-propanol, diethyl amine.

$C_{28}H_{38}O_{27}$, Cellobios Octaacetate.

Distribution between aqueous solutions of calcium thiocyanate and chloroform (II 825).

$C_{32}H_{49}O_9N$, Veratrin. Sesame Oil. (Int' Crit. Tables III 433).

$C_{34}H_{47}O_{11}N$, Aconitine.

Distribution between water and chloroform (Int. Crit. Tables III 433).

$C_{57}H_{104}O_6$, Triolein or Olive Oil.

Distribution between water and olive oil.
(Page numbers in Seidell II or Int. Crit. Tables III "ICT").

Acetic Acid	113	Ethylene Chloride	ICT 423
Acetone	ICT 425	Ethyl Formate	ICT 425
Acetourethane	203	Ethylvaleramide	ICT 430
Acridine	a	Guaiacol Acid Carbonate	ICT 431
tert-Amyl Alcohol	315	Heptylic Acid	566
Benzoic Acid	511	m- and p-Hydroxybenzoic Acid	529-30
Bromal Hydrate	87	Iodoacetic Acid	94
Bromoacetic Acid	86	Salicylamide	541
α Bromobutyric Acid	238	Methanol	ICT 422
α and β-Bromopropionic Acids	171	p-Methoxybenzoic Acid	591
α Bromovaleric Acid	295	Methyl Carbamate	122, 203
α Bromoisovaleric Acid	295	Monoacetin	307
Bromural	ICT 428	Pelargonic Acid	644
tert-Butanol	270	Phenol	379
2-Butanone	ICT 426	Phenylurethane	ICT 431
n- and Isobutyric Acids	257	o- and p-Phthalic Acids	574
Butyrochloral Hydrate	218	n- and Isopropanols	ICT 425
Caffeine	613	Propionic Acid	193
n- and Isocaproic Acids	440	Resorcinol	396
Caprylic Acid	620	Salicylic Acid	527
Chloral Hydrate	93	Sodium Salicylate	I 1178
Chloroacetic Acid	91	Three Sulfonals	317
Chloroform	ICT 422	Tetronal	317
β Chloropropionic Acid	171	Theobromine	552
Detonal	203	Theophyline	552
Diacetin	307	Thymol	674
Dichloroacetic Acid	79	Triacetin	307
Diethylvaleramide	ICT 432	Trichloroacetic Acid	70
Di- and Trihydroxybenzoic Acids	533	Trihydroxybutyric Acid	ICT 426
Dimethylvaleramide	ICT 430	Trional	317
Epronal	203	Urethane	203
Ethanol	ICT 425	n- and Isovaleric Acids	302
Ethoxycaffeine	613	Valeramide	ICT 427
Ethyl Acetate	ICT 426	Veronal	203
Diethyl Lactamide	ICT 430		

(a) See Acridine ($C_{13}H_9N$).

Cod Liver Oil - Isobutylurethane (Int. Crit. Tables III 430)

COTTONSEED OIL - Formic Acid (II 27), Methanol (II 48), Acetic Acid (II 113), Ethanol (II 150, see under ethanol), n-Propionic Acid (II 187), n-Propanol (II 205), Isopropanol (see under isopropanol), Butyric Acid (II 252), Isobutanol (II 270), Isoamyl Alcohol (II 315).

CORN, PEANUT, RAPE, and SOYA OILS - Aniline (II 415), Thymol (II 574).

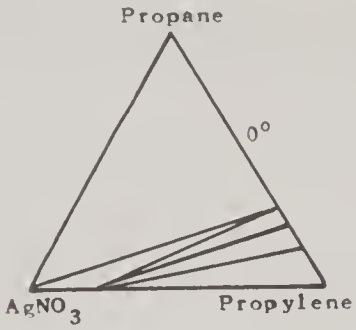
SESAME OIL - 17 Alkaloids, namely atropine, brucine, caffeine, cocaine, codeine, colchichine, coniine, dionine, eucaine, morphine, narcotine, nicotine, novocaine, pilocarpine, quinine, strychnine, veronal. (Wamossy, 1913).

TWELVE DYES - Isobutanol (II 830).

COLLODION - Acetic Acid (II 113), Phenol (II 387).

NOTE - Cross references among Ternary Nonaqueous Systems, which are beyond this page, refer to other listings of nonaqueous systems unless aqueous systems are specifically mentioned.

$AgNO_3$, Silver Nitrate - Propylene-Propane (Francis, 1951).



Compositions in gms. per 100 gms. liquid at 0°.

Lower Layer (propane negligible)		Upper Layer ($AgNO_3$ negligible)	
$AgNO_3$	Propylene	Propylene	Propane
73.5	26.5	100	0
75	25[a]	75	25[a]

(a) These two liquid phases are also in equilibrium with crystalline $AgNO_3$.

Silver nitrate shows relations similar to those of propylene with 1-butene but not with other olefins in absence of water. Propane is inert and can be replaced by any other inert liquid.

H_3BO_3, Boric Acid.

Distribution between glycerol and amyl alcohol (Int. Crit. Tables III 434).

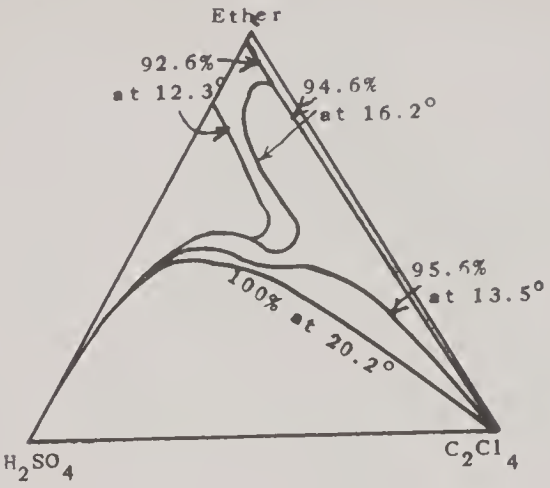
HF, Hydrogen Fluoride - n-Heptane containing 1.18 tp 1.56% sulfur in the form of pure sulfur compounds. (A. P. Lien, D. A. McCaulay, and B. L. Evering, Ind. Eng. Chem., 41, 2698, 1949). The percentages of sulfur removed by 20% of HF are as follows:

Radical	Mercaptan	Disulfide	Sulfide
Methyl		78	
n-Propyl	70		99
n-Butyl	58	37	
sec-Butyl	71		
tert-Butyl	96	77	
n-Amyl		19	
n-Hexyl			90
n-Octyl	24	9	
tert-Octyl	96		
n-Dodecyl	5	1	
tert-Dodecyl	82		

H_3PO_4, Phosphoric Acid
H_2SO_4, Sulfuric Acid } Ligroin-Camphor (II 679, ref.).

SULFURIC ACID - Ether-Tetrachloroethylene (Tian, 1946).

No numerical data are given except those shown on the graph. The concentrations of sulfuric acid shown are recalculated. The binodal curves with diluted acid show sharoly reversed curves because the systems are really quaternary (four components).



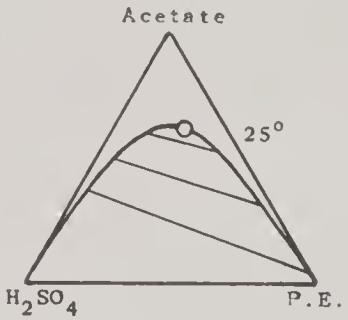
SULFURIC ACID - Valeric Acid-Benzine (I 599, II 301).

Correction: The hydrocarbon was not benzene but benzine or gasoline.

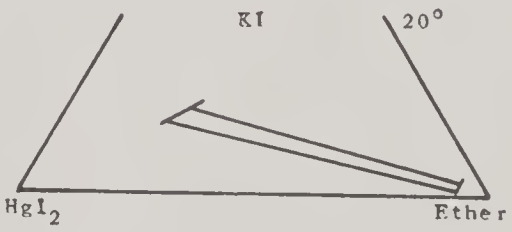
SULFURIC ACID - Isopropyl Acetate-Petroleum Ether.

(Francis, 1950, p. 266). Compositions in gms. per 100 gms. liquid at 25°.

Lower Layer			Upper Layer		
H_2SO_4	Acetate	P.E.	H_2SO_4	Acetate	P.E.
54	45	1	0	4	96
40	55	5	4	32	64
30	60	10	9	55	36
17	63	20	Plait Point		



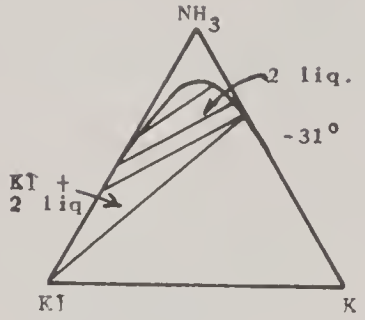
HgI_2, Mercuric Iodide-Potassium Iodide-Ether (I 644).



I_2, Iodine.

Distribution between ether and ethylene glycol (I 688). Distribution between glycerol and carbon tetrachloride, chloroform, ether, or benzene (I 669).

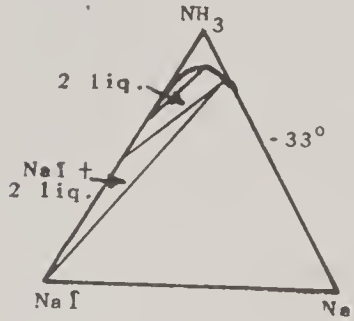
K, Potassium - Ammonia-Potassium Iodide (Cubiciotti, 1949).



Gms. per 100 gms. at -31°.

Lower Layer			Upper Layer		
KI	NH_3	K	KI	NH_3	K
64.5	35.2	0.3	3.6	69.1	27.3
49.5	50.1	0.4	2.5	75.5	22.0
43.8	55.6	0.6	3.0	82.1	14.9
32.2	65.9	1.9	3.9	83.0	13.1

Na, Sodium - Ammonia-Sodium Iodide (Cubiciotti, 1949).



Gms. per 100 gms. at -33°.

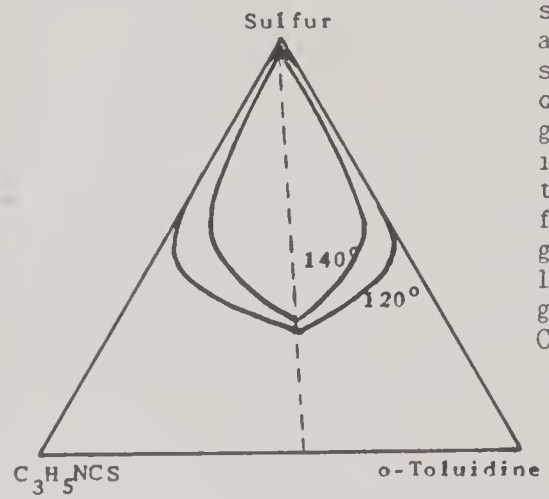
Lower Layer			Upper Layer		
NaI	NH_3	Na	NaI	NH_3	Na
47.2	52.8	0	1.65	79.55	18.8
44.3	55.5	0.2	1.67	83.9	14.4
30.3	69.5	0.2	3.3	85.5	11.2
15.8	82.3	1.9	1.7	88.9	9.4

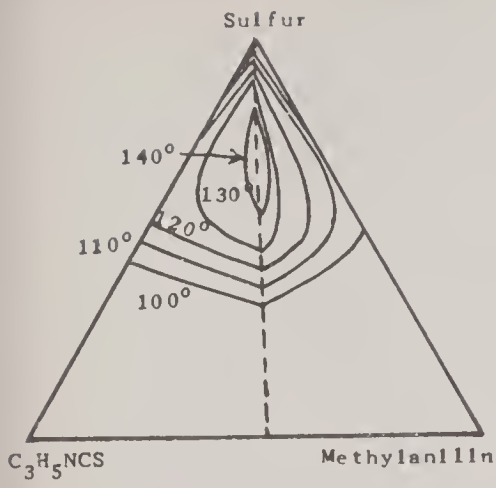
Data at -43°.3° (M. J. Sienko, J. Am. Chem. Soc., 71, 2707, 1949).

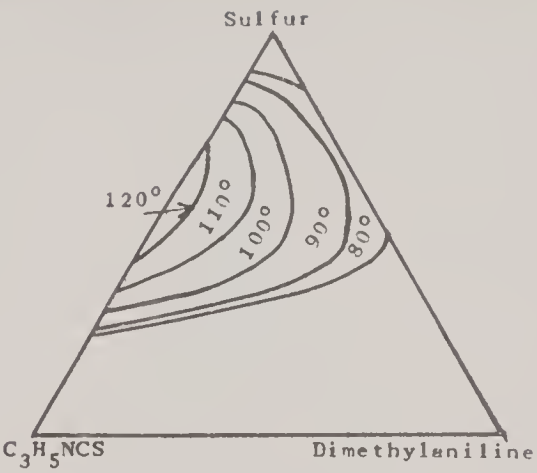
% Na in	Lower Layer	Upper Layer
	4.4	7.1
	3.2	9.0

S, Sulfur - C_3H_5NCS, Allyl Isothiocyanate - o-Toluidine, Methylaniline, or Dimethylaniline.

(E. F. Zhuravlev, J. Gen. Chem., 10, 1926, 1940; Chem. Abstracts 35, 3971). Mixing temperatures were observed for about 150 synthetic binary and ternary mixtures in these systems and isothermal binodal curves were interpolated on the graphs with compositions in gms. per 100 gms. liquid. Since in the first two systems two of the components form an equimolar compound, the graphs are divided by an isologous line into two separate ternary diagrams. Cf. water-acetic anhydride-CS_2.

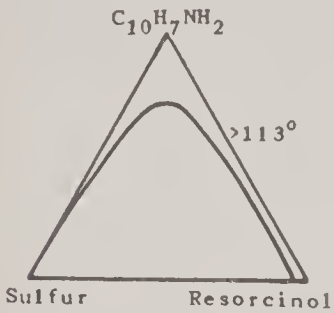






SULFUR - Resorcinol - Naphthyl Amine

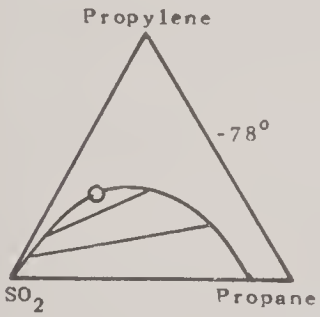
(Hyrnakowski, Staszewski, and Szmyt, 1937).



A study primarily of solid phases at lower temperatures.

SO_2 Sulfur Dioxide. See toluene-petroleum.

SULFUR DIOXIDE-Propane-Propylene (Francis, 1950, p. 265).



Gms. per 100 gms. liquid at -78°.

Lower Layer			Upper Layer		
SO_2	C_3H_6	C_3H_8	SO_2	C_3H_6	C_3H_8
96	0	4	18	0	82
86	9	5	20	23	57
76	16	8	33	34	33
63	25	12	Plait Point		

SULFUR DIOXIDE - Several pairs of hydrocarbons at -18° (II 312). In most of the systems one hydrocarbon (aromatic or olefin) is miscible with SO_2, and the other (paraffin or naphthene) is not miscible, as in the propane-propylene graph. The other systems (paraffins plus naphthenes) form a double nonconsolute pair (neither hydrocarbon miscible with SO_2) except one, SO_2-benzene-hexene, which does not give two liquid phases. The pairs are as follows:

TERNARY NONAQUEOUS SYSTEMS

Miscible with SO_2	Not miscible with SO_2
Benzene	Pentane
Benzene	Hexane
Benzene	Cyclohexane
Pentene	Pentane
Hexene	Pentane
Hexene	Hexane
Toluene	Octane
Toluene	Kerosene
Xylene	Naphthenes
Octenes	Naphthenes

More miscible with SO_2	Less miscible with SO_2
Cyclohexane	Nonane plus Decane
Naphthenes	Paraffinic Gasoline

Corrections: In line 10 of the paragraph on p. II 312 change "completely insoluble" to"incompletely miscible". In line 12 change "Naphthalene" to "Naphthenes". The claim (d) that "Naphthenes may be separated from paraffins." is not proven since the naphthenes used were much lower in molecular weight than the paraffins. It is inconsistent with other data in the literature e.g. Leslie (1934, p. 596) and Francis (1944, p. 769).

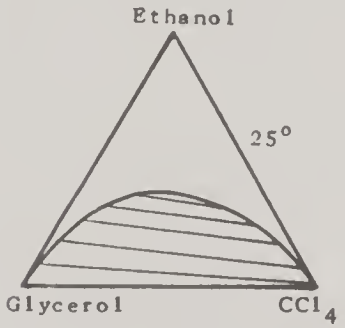
$SbCl_3$, Antimony Trichloride. See toluene-petroleum.

$ZnCl_2$, Zinc Chloride-Picoline-seven Alcohols (II 420).

CCl_4, Carbon Tetrachloride. See iodine-glycerol (I 669); methanol-vaseline oil (II 5).

CARBON TETRACHLORIDE-Ethanol-Glycerol.

(H. J. McDonald, A. F. Kluender, and R. W. Lane, J. Phys. Chem., 46, 946, 1942).



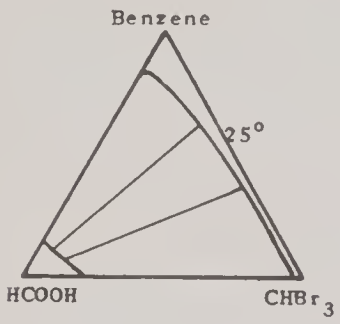
Gms. per 100 gms. liquid at 25°.

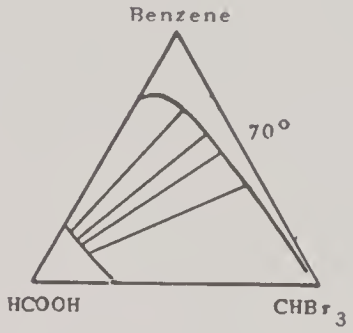
Upper Layer			Lower Layer		
Glycerol	Ethanol	CCl_4	Glycerol	Ethanol	CCl_4
94.5	4.5	1.0	0.1	0.3	99.6
84.6	12.0	3.4	0.2	3.0	96.8
73.2	19.2	7.6	0.7	5.3	94.0
61.2	25.1	13.7	1.5	9.0	89.5
51.7	27.7	20.6	7.3	17.0	75.7
38.1	28.6	33.3	-	-	-

CS_2, Carbon Disulfide. See acetic acid-acetic anhydride.

$CHBr_3$, Bromoform-Formic Acid-Benzene.

(A. M. Avenarins and D. N. Tarasenkov, J. Gen. Chem. (U.S.S.R.) 16, 1776, 1946; Chem Abstracts 41, 5372).





Gms. per 100 gms. saturated solution at 25°, 50°, and 70°.

t°	HCOOH	Benzene	$CHBr_3$	t°	HCOOH	Benzene	$CHBr_3$
25	9.2	81.8	9.0	50	3.1	15.3	81.6
	6.3	61.6	32.1		83.2	6.3	10.5
	4.9	50.0	45.1		84.2	8.9	6.9
	3.7	34.6	61.7				
	2.5	15.5	82.0	70	23.9	68.6	7.5
	88.0	6.4	5.6		19.6	64.9	15.5
	85.8	3.6	10.6		14.5	56.3	29.2
					10.6	45.3	44.1
50	13.6	77.8	8.6		8.4	32.9	58.7
	12.0	71.0	17.0		5.7	15.1	79.2
	9.7	59.4	30.9		75.4	13.9	10.7
	6.3	46.7	47.0		74.3	10.4	15.3
	5.3	34.0	60.7[a]				

(a) The original says 50.7, evidently a typographical error.

The authors state that all of the tie lines point toward the formic acid corner (isologous lines) so that the formic acid would show no selectivity for a benzene-bromoform mixture.

$CHCl_3$, Chloroform. See iodine-glycerol (I 669), methanol-vaseline oil (II 15).

CHLOROFORM-GLYCEROL.

Distribution of acetic acid (Int. Crit. Tables III 434), propionic acid (II 193) or isovaleric acid (II 306). The last system contains an isopycnic or tie line connecting compositions having equal densities.

CHLOROFORM-ETHER-STARCH TRIACETATE.

(Schulz and Jirgensons, 1940). Scattered data.

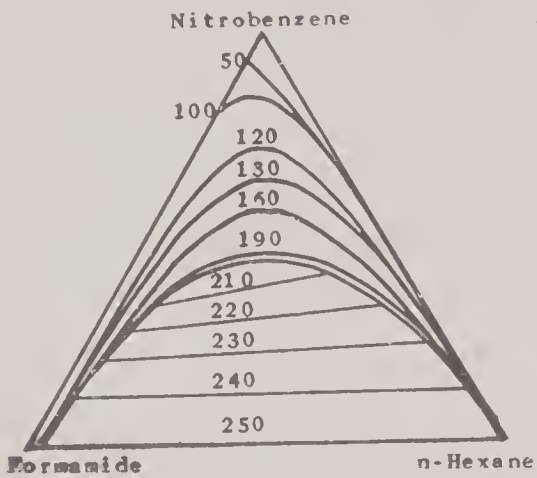
CH_2O, Formic Acid. See bromoform-benzene; acetonitrile-isooctane.

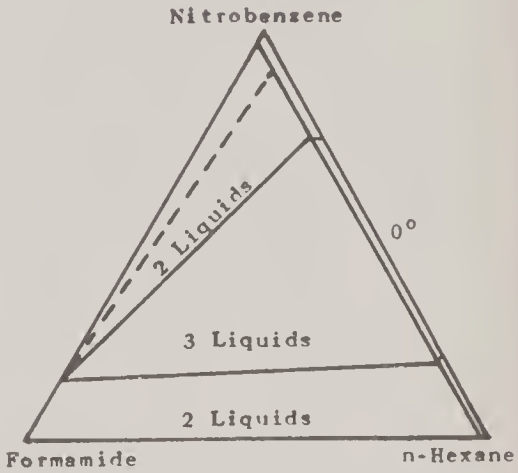
FORMIC ACID.

Distribution between methanol and isooctane (II 31); acetone and glycerol (II 31); methoxyethanol and isooctane (2,2,4-Trimethylpentane) (II 31); distribution between formic acid and petroleum ether of ethanol, n-propanol, or isoamyl alcohol (Shilow and Lepin, 1922, p. 387).

CH_3ON, Formamide, $HCONH_2$-Nitrobenzene-n-Hexane.

(E. Jänecke, Z. physik. Chem., 183, 71-5, 1939).





Numerous isotherms are presented in the first graph. The curves up to 190° are binodal curves. The lowest curve is not a binodal curve but that bounding compositions of a liquid-vapor phase at the critical temperatures of the upper layer. The tie lines show these several temperatures.

The C.S.T. of nitrobenzene-n-hexane, 20.2°, is raised slightly to 24.9° by the formamide. At temperatures below this the graph contains an area showing three liquid phases. The 0° isotherm is plotted on the basis of subcooled nitrobenzene (m.p. 5.5°). There is only a trace, 0.3%, of hexane in the formamide layer, and 1-2% of formamide in the other two layers. But there are 12 and 22% nitrobenzene in the other two layers, respectively, and 22% hexane in the nitrobenzene layer. (these percentages have been converted to wt. %). There is an isopycnic (dashed line) connecting compositions of equal density 1.15 in equilibrium. The nitrobenzene phase contains 7% hexane and 2% formamide by weight .

A triple isopycnic (three liquid phases of equal density in equilibrium) can be made up by a modification of this system. The density of the hydrocarbon phase is increased by the addition of carbon tetrachloride. To prevent this from causing mixing with the nitrobenzene phase, a higher hydrocarbon, n-hexadecane, is substituted for hexane, and an equal volume mixture of aniline and nitrobenzene is substituted for the latter. Pure aniline cannot be used because it mixes with formamide. The exact proportions of the five components, aniline, carbon tetrachloride, formamide, hexadecane, and nitrobenzene depends upon the temperature. The density of the three phases is 1.15.

TERNARY NONAQUEOUS SYSTEMS

FORMAMIDE - Diethyl Tartrate-Ethylene Bromide.

Distribution (Int. Crit. Tables III 434).

CH_4, Methane. See propane-stearic acid.

CH_4O, Methanol. Effects of several salts on the miscibility temperature with hexane are given by Howard and Patterson (1926). Effects of zinc chloride are given on miscibility of methanol and six other alcohols with picoline (II 420).

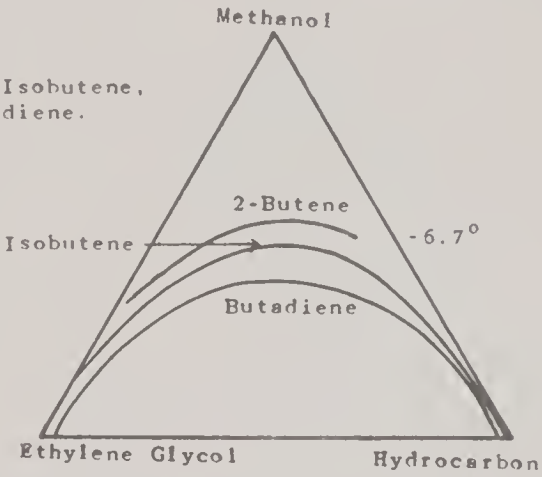
Distributions between methanol and vaseline oil are given for carbon tetrachloride (II 5), chloroform (II 15), diethyl amine (II 280), naphthalene (II 650), and camphor (II 679).

Distribution between methanol and isooctane (2,2,4-trimethylpentane) at 0° are given for formic acid (II 31), butyric acid (II 258), caprylic acid (II 620), lauric, palmitic, oleic, and linoleic acids, (A. E. Smith and Norton, 1932).

METHANOL-ETHYLENE GLYCOL-2-BUTENE, Isobutene, or butadiene.

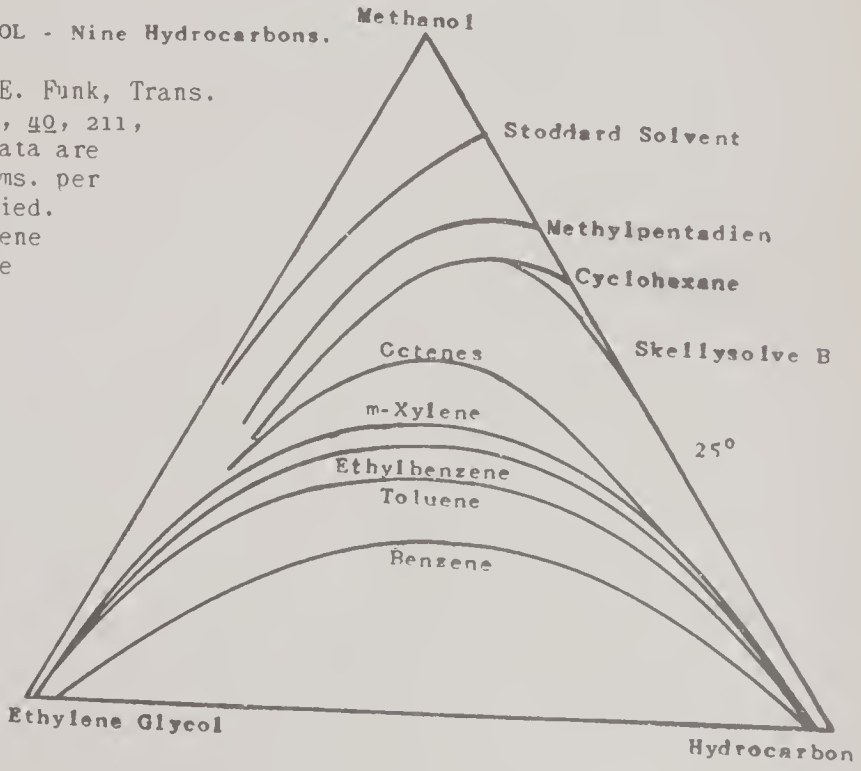
(A. S. Smith and Braun, 1945).

No numerical data or tie lines are given. The isothermal curves at -6.7° are almost symmetrical, with the apices at about 39, 48, and 52% methanol respectively.



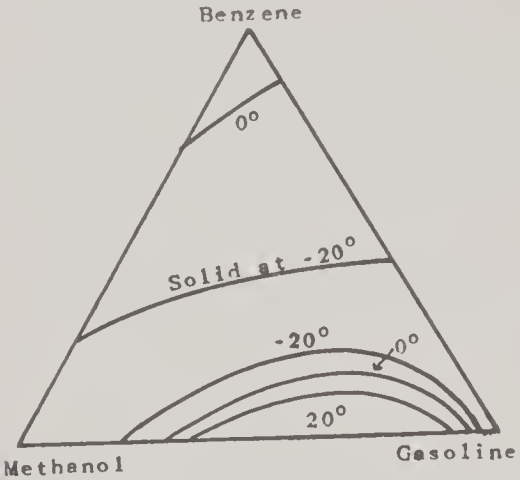
METHANOL-ETHYLENE GLYCOL - Nine Hydrocarbons.

(A. S. Smith and J. E. Funk, Trans. Am. Inst. Chem. Engrs., 40, 211, 1944). No numerical data are given. The graph in gms. per 100 gms. liquid is copied. A blend of 65% dipropylene glycol and 35% ethylene glycol was tried as a solvent, but no data are given.



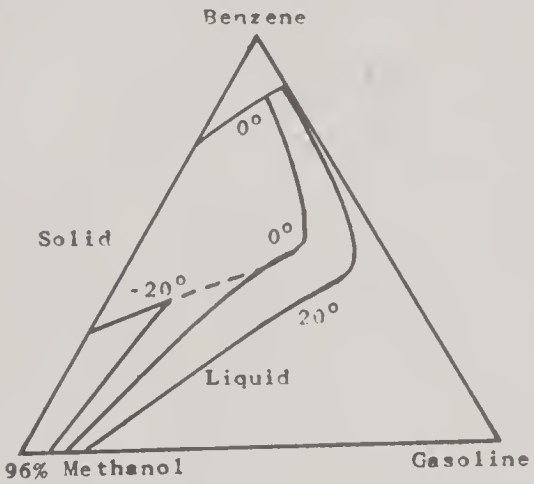
METHANOL-GASOLINE-ACETONE or BENZENE

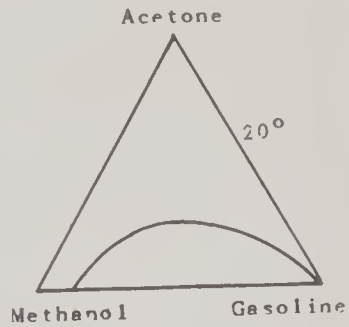
(F. M. E. Shepherd, 1934). The gasoline had a density of 0.7573 and a boiling range or 47.5 to 197.5°.



No numerical data are given. The graphs are copied in gms. per 100 gms. liquid. In the benzene graphs equilibria with solid benzene are shown at 0° and -20° in addition to the binodal curves

The second graph shows the profound effect of 4% water in the methanol on the phase equilibrium curves. They are raised greatly and disproportionately on the hydrocarbon side, giving sharp reverse curves which are characteristic of four component systems (including water).





METHANOL-TRIETHANOLAMINE-ISOBUTENE and Butadiene.

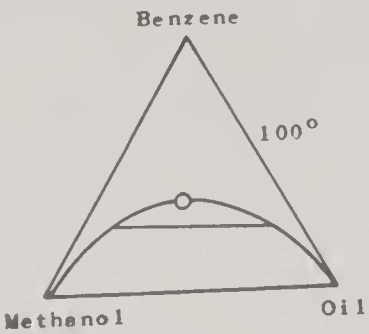
(A. S. Smith and Braun, 1945). A mixture of 43% methanol and 57% triethanolamine was tried as a selective solvent for the two olefins.

METHANOL.

Distribution of n-butyric acid between methanol and isooctane (II 258).

METHANOL - Diethyl Amine - Vaseline Oil (II 280).

METHANOL-BENZENE-LUBRICATING OIL. (Francis, 1950).



The oil was a commercial paraffinic oil (C.S.T. with ethanol 128°). Compositions in gms. per 100 gms. liquid at 100°

Upper Layer			Lower Layer		
Methanol	Benzene	Oil	Methanol	Benzene	Oil
96	0	4	2	0	98
61	27	12	12	25	63
35	35	30	Plait Point.		

METHANOL-BENZENE-RAPESEED OIL.

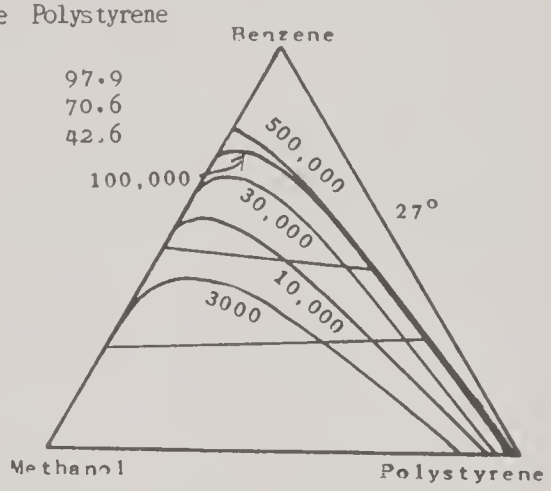
(A. Boutaric and G. Corbet, Comot. rend., 184, 1446, 1927). Effect of percentage of oil on C.S.T. of methanol-benzene. By extrapolation that of the binary system was estimated to be 29°. Since benzene is miscible with methanol at much lower temperatures, it seems possible that the methanol used was not anhydrous.

METHANOL-BENZENE-POLYSTYRENE.

(Schulz and Jirgensons, 1940). The figures on the curves are molecular weight of polystyrene. The two tie lines are for the 500,000 M.W. system. Compositions in gms. per 100 gms. liquid at 27°.

Sol Phase (Polystyrene negligible)		Gel Phase		
Methanol	Benzene	Methanol	Benzene	Polystyrene
100	0	2.1	0	97.9
75	25	3.3	26.1	70.6
45.1	54.9	7.6	49.8	42.6

Scattered data are given also for the amounts of reagents required to precipitate solutions of various high molecular weight substances in the systems, water-acetone-nitrocellulose; ether-chloroform-starch triacetate; cyclohexane-benzene-polymethacrylic acid ester.



METHANOL-HEXANE-FATTY ACIDS.

The effects of four normal fatty acids, C_5 to C_8, in lowering the C.S.T. of methanol and hexane (33.6°) were observed (II 53, ref.).

METHANOL - Isooctane (2,2,4-Trimethylpentane).-

Distribution of methyl esters of five fatty acids((caprylate, laurate, palmitate, oleate, linoleate (Henriques, 1933).

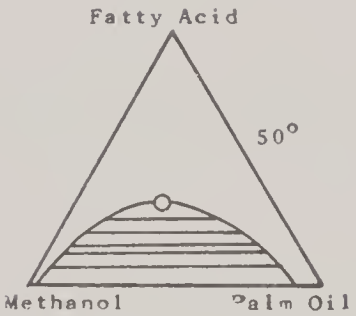
Correction: The third column of Table II is headed "Alc. layer". From the legend of Fig. 2 and the summary this must be methanol for the upper part of the table and methoxyethanol for the lower part.

METHANOL - NAPHTHALENE - VASELINE OIL (II 650).

METHANOL for Deacidification or Purification of Vegetable or Animal Oils in the next four systems.

METHANOL - Fatty Acid-Palm Oil.

(J. M. Martinez-Moreno and C. Paniagua, Bull. soc. chim., 1949, 388). Compositions in gms. per 100 gms. liquid at 50°.



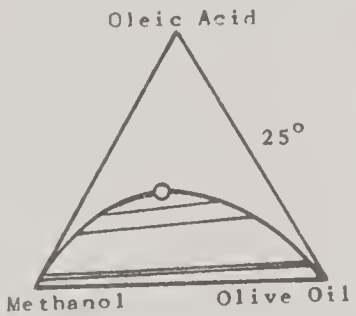
Upper Layer			Lower Layer		
Methanol	Acid	Oil	Methanol	Acid	Oil
96.4	0.73	2.87	12.15	0.92	86.93
94.0	3.11	2.9	11.70	3.33	84.97
90.81	5.57	3.62	13.69	5.60	80.71
85.7	9.6	4.7	14.8	10.1	75.1
81.02[a]	12.53	6.45	18.15	12.79	69.0
67.06	20.39	12.55	25.33	19.85	54.82
41.0	24.2	34.8	Plait Point		

(a) Original gives 51.02, evidently a typographical error.

METHANOL - Oleic Acid-Olive Oil.

(J. M. Martinez-Moreno, Anales fis. y quim. (Madrid), 43, 261, 1947. Chem. Abstracts, 41, 6420; Ruis and Martinez-Moreno, 1947).

Compositions in gms. per 100 gms. liquid at 25°.



Upper Layer			Lower Layer		
Methanol	Acid	Oil	Methanol	Acid	Oil
99.18	0.74	0.08	3.7	1.41	94.89
96.3	3.1	0.6	5.63	3.73	90.64
93.9	5.05	1.05	6.5	6.05	87.45
79.8	17.9	2.3	11.9	21.2	66.9
67.6	26.4	6.0	19.4	28.5	52.1
40.05	32.4	27.52	Plait Point		

METHANOL-FATTY ACIDS-COD LIVER OIL or Hake Liver Oil.

(A. Rius and J. Gutierrez-Jodra, Anales fis. y quim. (Madrid) 45B, 245, 1949; Chem.Abstracts 43, 7724).

METHANOL - Nonsaponifiables - Cod Liver Oil or Hake Liver Oil.

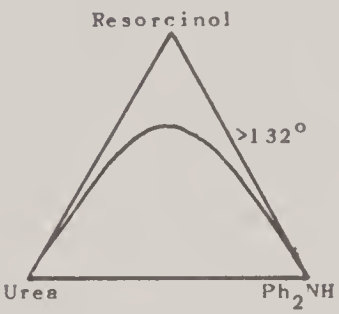
(L. Gutierrez-Jodra, Anales fis. y quim. (Madrid) 45B, 1453, 1949; Chem. Abstracts 44, 6584a).

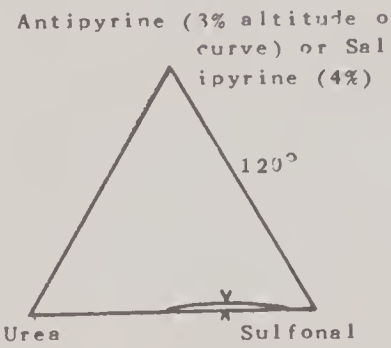
CH_4ON_2, Urea, $CO(NH_2)_2$ - Urethane, $NH_2COOC_2H_5$ - Phenacetin.

(K. Hrynokowski and F. Adamanis, 1937, Roczniki Chem., 17, 132, 1936; Chem. Abstracts 31, 4881). A study primarily of solid phase equilibria. At about 130°, however, two liquid layers are formed.

UREA - Resorcinol - Diphenyl Amine.

(Hrynokowski, Staszewski, and Szmyt, 1937).





UREA - Sulfonal, $(CH_3)_2C(SO_2C_2H_5)_2$ - Antipyrin or Salipyrin.

(K. Hrynokowski and H. Szmyt, Z. physik. Chem., A181, 113, 1937).

C_2Cl_4, Tetrachloroethylene. See sulfuric acid-Ether.

Chloro-, Dichloro-, Trichloro-, and Bromoacetic Acids. See acetone-glycerol (II 68, 78, 86, 89).

C_2H_3N, Acetonitrile, CH_3CN. See polystyrene-benzyl benzoate.

ACETONITRILE.

Distribution of seven acids; lauric, oleic, maleic, fumaric, and three phthalic acids between acetonitrile and isooctane (2,2,4-trimethyl pentane) at 0° (A. E. Smith and Norton, 1932).

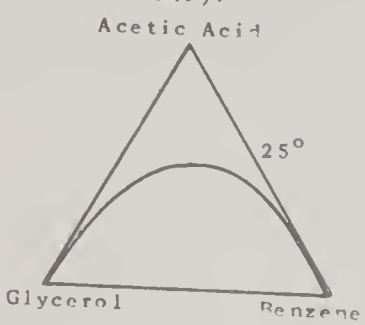
$C_2H_4Br_2$, Ethylene Bromide. See formamide-diethyl tartrate.

C_2H_4OS, Thioacetic Acid. Acetone-Glycerol (II 118).

$C_2H_4O_2$, Acetic Acid. See chloroform-glycerol; methanol-isooctane; methoxyethanol-isooctane; acetone-glycerol; aniline-cyclohexane.

ACETIC ACID - Glycerol-Benzene (Siggia and Hanna, 1949).

The graph was shown but without numerical data. The table (III) was merely a list of sample compositions to be analyzed. The apex of the curve is at about 50% acetic acid.

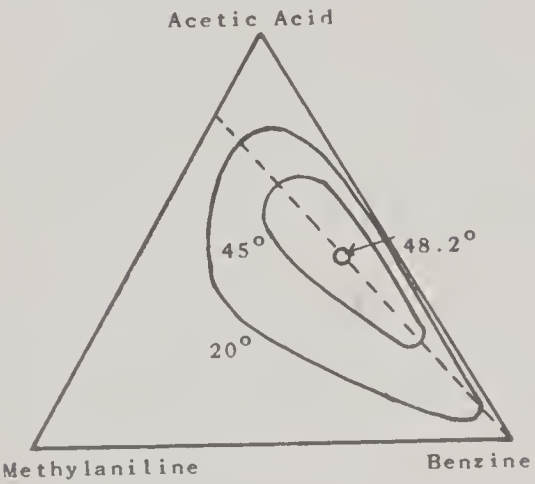


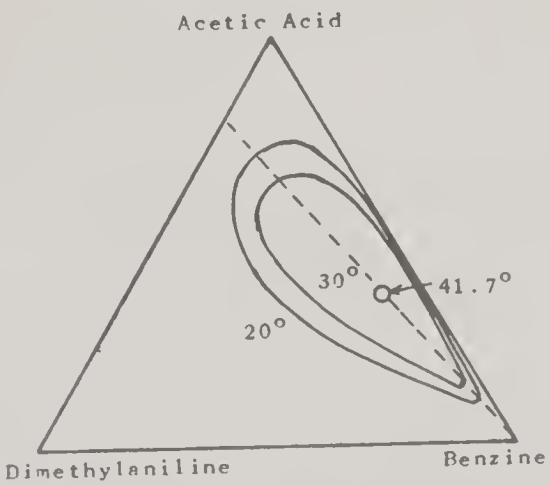
ACETIC ACID.

Effect of acetic acid on the C.S.T. of acetic anhydride with carbon disulfide, cyclohexane, or decanes (Jones and Betts, 1928).

ACETIC ACID - 'Benzine' - 'Aniline, Methylaniline, or Dimethylaniline.

(E. F. Zhuravlev, J. Phys. Chem. (U.S.S.R.) 12, 639, 1938; 13, 679, 1939; Chem. Abstracts 34, 315, 1544). The "benzine" was a gasoline hydrocarbon mixture of 100-125° boiling range.





In each system the major axis of the closed curves is along an isologous line (dashed line) from the benzine corner to the opposite side at 77% and 80% acetic acid respectively. The ternary critical points are marked, and also seem to be on these lines.

Data at 25° also are given.

Gms. per 100 gms. liquid.

Methylaniline System at 20°

PhNHMe	AcOH	Benzine
10	78.9	11.1
20	72.0	8.0
30	61.5	8.5
42.2	37.8	20
30.7	19.3	50
18.9	11.1	70
5.4	4.6	90
1.5	4.7	93.8
0.6	29.4	70
3.7	76.3	20

Temperature 45°

19	60.8	20.2
24	46	30
8.4	21.6	70
5.8	24.2	70
9.5	60.5	30

Data at 30° and 40° also are given.

Dimethylaniline System at 20°

$PhNMe_2$	AcOH	Benzine
10	77.5	12.5
20	70.8	9.2
30	55	15
24	26	50
14.5	15.5	70
2.2	7.8	90
0.5	30	69.5
3.0	70	27.0

Temperature 30°

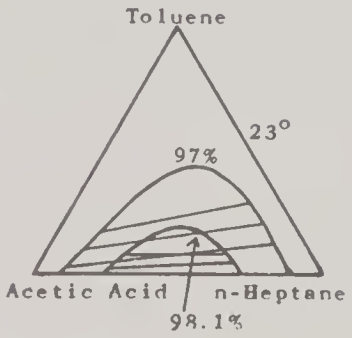
1.6	20	78.4
3.5	50	46.5
6.4	70	23.6
20	67	13
25.6	54.4	20
24.2	35.8	40
17	23	60
3	12	85

TERNARY NONAQUEOUS SYSTEMS

ACETIC ACID-TOLUENE-n-HEPTANE. (Othmer and Tobias, 1942a).

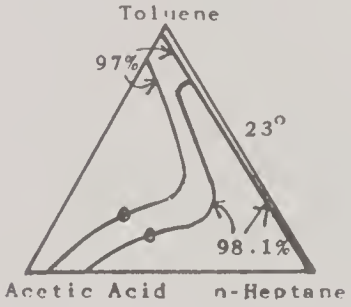
Compositions in gms. per 100 gms. liquid at 23°.

97% Acid	Toluene	n-Heptane
87	0	13
75	9	16
60.5	19	20.5
19	43	38
6.5	33.5	60
8	0	92
98.1% Acid		
70	0	30
54.5	9.5	36
27	18	55
24.5	0	75.5



Distribution: Percentage toluene in layers.

97% Acid	Heptane
1.2	12.0
8.3	19.0
14.2	27.0
98.1% Acid	
0.5	2.0
5.3	7.1



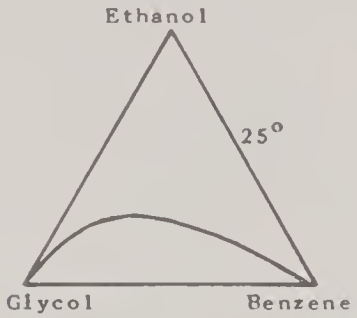
This system is really a quaternary system since without the water there would be no separation into two layers. The validity of the tie lines in this system was questioned (Francis, 1950, p. 251) because the acid layer would contain practically all of the water and being more dilute would dissolve less heptane than that indicated by the phase boundary curve. In fact for such a quaternary system the latter would be expected to be a sharp reverse curve as in the systems of 96% methanol-benzene-gasoline; 95% ethanol-benzene-lubricating oil, and 93.5% sulfuric acid-ether-tetrachloroethylene. Observations in the compiler's laboratory indicate this to be the case (second graph). The apparent discrepancy may be reconciled if the curves of Othmer and Tobias are not phase boundary curves but those for "equilibrium mixtures" (Cf. the discussion for the systems 70% methanol-phenols-methylnaphthalene below among Quaternary Aqueous Systems). These are curves showing compositions of the two phases when they are nearly equal in volume, and would coincide with the phase boundary curve only for a really ternary system. An equilibrium mixture curve may be operationally more significant than the phase boundary curve, but it is indefinite since it varies in position with the relative volumes of the layers.

C_2H_5OCl, β-Chloroethanol or Ethylene Chlorohydrin. See xylene-gasoline.

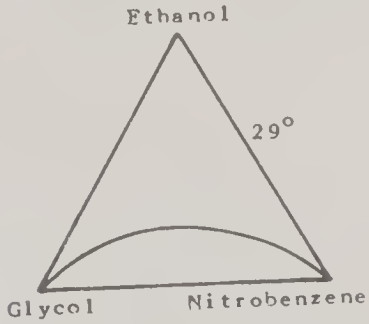
C_2H_5O, Ethanol. See $ZnCl_2$-picoline; carbon tetrachloride-glycerol; formic acid-petroleum ether; polystyrene-benzyl ether.

ETHANOL. Effects of salts on mutual miscibility temperatures of ethanol with a paraffinic oil (b.p. 160-180°) are given by Howard and Patterson (1926) (II 152). The high values of mutual miscibility temperatures are inconsistent with some other observations (Cf. Francis, 1950, p. 283).

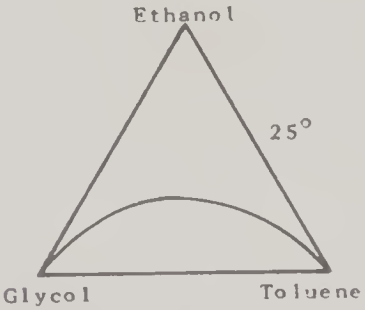
ETHANOL-ETHYLENE GLYCOL-BENZENE, Toluene, Xylene or Nitrobenzene (II 154). The data of Trimble and Frazer (not Fraser) were presented as 'volume per cent'. From the text this seems to be 'cc. per 100 cc. total separate volumes' rather than 'cc. per 100 cc. homogeneous mixture' (II 154). On this basis the data were recalculated to gms. per 100 gms. solution.



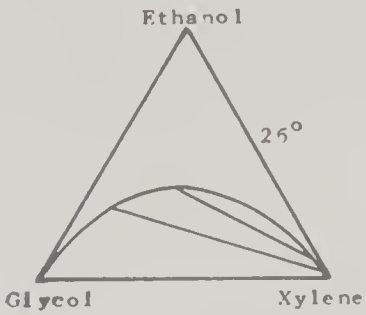
Temp.	Glycol	Ethanol	Benzene
25°	95.4	3.0	1.6
	79.5	13.0	7.5
	68.5	18.9	12.6
	62.6	21.8	15.6
	49.8	25.4	24.8
	39.3	25.8	34.9
	21.2	19.7	59.1
	6.0	9.4	84.6



	Glycol	Ethanol	Nitro-Benzene
29°	85.1	7.35	7.55
	66.5	15.9	17.6
	62.2	17.9	19.9
	46.1	21.5	32.4
	34.0	21.0	45.0
	25.6	18.2	56.2
	12.3	11.9	75.6
	6.7	8.2	85.1



25°	Glycol	Ethanol	Toluene
	93.5	4.2	2.3
	70.4	20.9	8.7
	60.0	25.9	14.1
	46.9	30.2	22.9
	35.5	29.8	34.7
	24.9	26.4	48.7
	13.8	18.8	67.4



	Glycol	Ethanol	Xylene
26°	81.2	15.5	3.3
	56.7	32.0	11.3
	45.7	36.2	18.1
	35.5	36.2	28.2
	25.7	33.4	40.9
	20.6	30.0	49.4
	15.0	25.2	59.8
	9.1	18.4	72.5

TERNARY NONAQUEOUS SYSTEMS

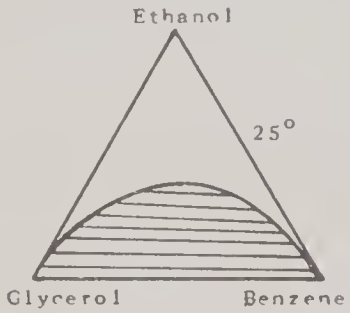
Distributions of ethanol between ethylene glycol and o-xylene or methyl-n-amyl ketone were calculated from activity coefficients and plotted in moles per mole of solvent. (Scheibel, 1950). These were recalculated to weight percentages in the two layers as follows:

Glycol	Xylene	Glycol	Ketone
29	4	5.1	3
36	7	8.6	5
		13.1	7.6

The former are plotted on Trimble and Frazer's graph above.

ETHANOL - Lactic Acid-Benzene (II 141, ref.).

ETHANOL - Glycerol-Benzene (II 141, ref., 155).



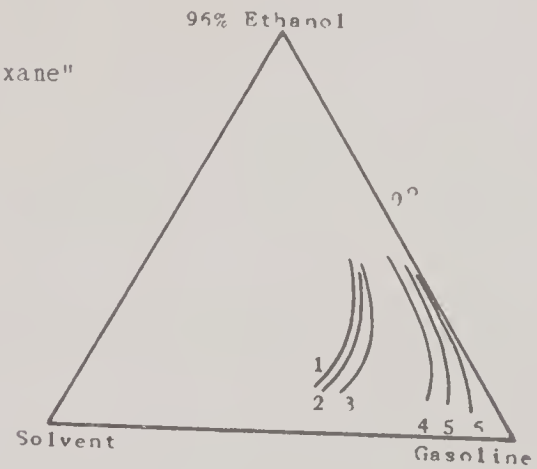
ETHANOL - Gasoline-Eleven Solvents (II 152).

The alcohol was 96% ethanol.

Correction: Instead of "cyclohexane" read "cyclohexanol".

Graphs

1 Benzene
2 Castor Oil
3 Acetone
4 Ether
5 Terpineol and Isopropanol
6 Other solvents, butanols, amyl alcohol, cyclohexanol, and butyl cresol.

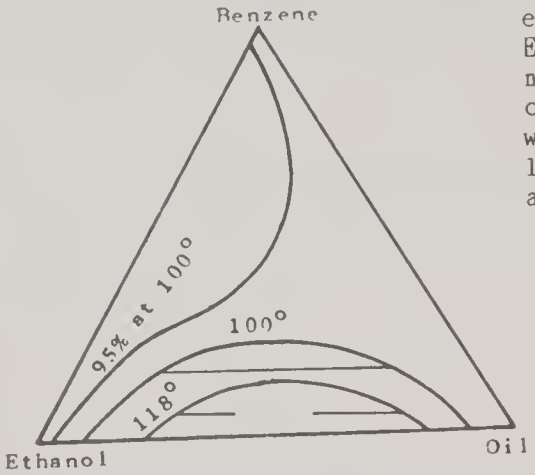


ETHANOL - Benzene-Paraffin or Cerosin.

(G. Armani and G. A. Rodano, J. Soc. Chem. Ind. 31, 912, 1912). Determination of cerosin in paraffin by its C.S.T. in ethanol-benzene mixtures. Cerosin 50°, paraffin about 25°.

ETHANOL - Benzene-Lubricating Oil.

(Francis, 1950, p. 250). The oil was a paraffinic lubricating oil (C.S.T. with ethanol 128°). Absolute ethanol shows normal curves. 95% Ethanol which really forms a quaternary system, shows a sharp reverse curve because water is incompatible with hydrocarbons, even benzene at low concentrations of a homogenizing agent like ethanol.



The curve is similar to that of 96% methanol-benzene-gasoline. Compositions in gms. per 100 gms. liquid.

t°	Upper Layer			Lower Layer		
	100% Ethanol	Benzene	Oil	100% Ethanol	Benzene	Oil
100	91	0	9	7	0	93
	66	15	19	16	14	70
	41	20	39	Plait Point		
118	81	0	19	16	0	84
	71	5	24	21	5	74
	46	10	44	Plait Point		
	95% Ethanol					
100	97	0	3			
	70	20	10			
	30	40	30			
	11	69	20			
	5	95	0			

The lower layer contains a negligible concentration of water and ethanol. There is no plait point.

Distribution of ethanol between ci al and lemon oil. (Int. Crit. Tables III 434).

ETHANOL-Oleic Acid-Olive Oil.

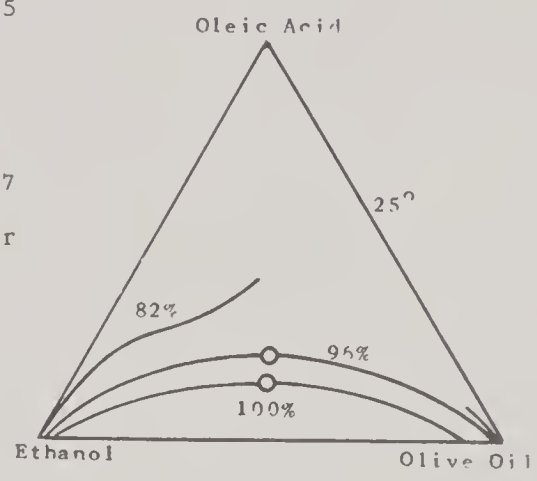
(Rius and Martinez-Moreno, 1947). Compositions in gms. per 100 gms. liquid at 25°.

(Data of Rius and Martinez-Moreno, 1947, Cont.).

% Ethanol	Upper Layer			Lower Layer		
	Ethanol	Acid	Oil	Ethanol	Acid	Oil
100	96.9	0.56	2.54	9.83	0.50	89.77[a]
	92.0	3.44	4.56	13.7	2.32	83.98
	84.6	6.86	6.54	16.8	4.71	77.49[a]
	75.4	11.3	13.3	23.6	8.91	67.5
	59.4	14.39	26.25	-	-	-
	-	-	-	34.3	12.65	53.1
	44.6	14.2	41.2	Plait Point		
96	98.44	0.59	0.97	5.71	0.89	93.40
	92.92	5.65	1.43	6.93	4.15	88.92
	85.3	11.1	3.6	9.2	10.45	80.35
	64.5	21.3	14.2	21.0	19.3	59.7
	53.5	23.1	23.4	-	-	-
	-	-	-	30.4	23.0	46.6
	39.26	23.74	37.0	Plait Point		
82	98.9	0.95	0.15	5.3	2.03	92.67
	96.75	2.99	0.26	6.0	7.81	86.79[b]
	73.0	23.2	3.76			
	53.9	32.9	13.2			
	38.4	36.6	25.0			
	30.1	40.4	29.5			
	No Plait Point					

Data for 96% ethanol at 18.5° also are given.

(a) These probably should be 89.67 and 78.49 respectively.
(b) Probably a typographical error for 86.19.



Similar data for removal of fatty acids from cod liver oil and hake liver oil are given by Rius and Gutierrez-Jodra (1949) and of non-saponifiables from cod liver oil by Gutierrez-Jodra (1949).

$C_2H_6O_2$, Ethylene Glycol. See iodine-ether; ethanol-four aromatics or methyl-n-amyl ketone.

ETHYLENE GLYCOL - Acetone or Isopropanol-Butadiene or Isobutene.

(A. S. Smith and Braun, 1945). Only a few selectivities are given.

ETHYLENE GLYCOL - Acetone - Benzene, Toluene, Xylene, Chlorobenzene, Bromobenzene, Nitrobenzene (II 157-8).

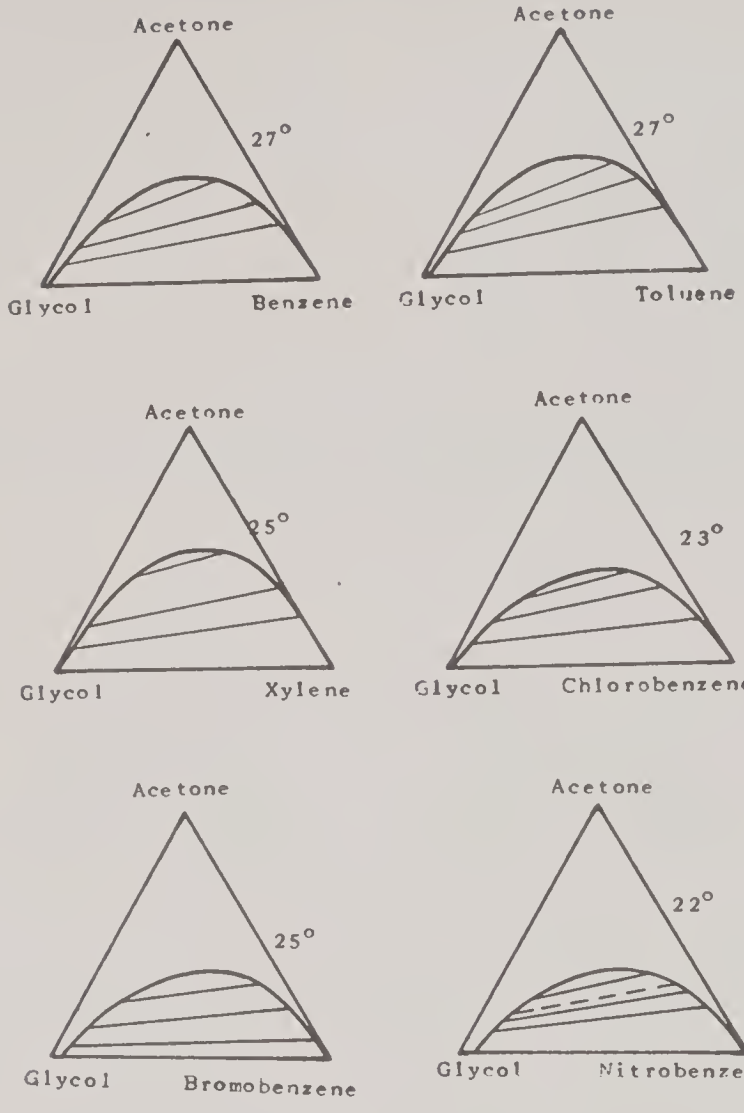
Correction: The column headings for the binodal curves are interchanged. They should have been in the order glycol, aromatic, acetone (all six times). In the distribution for the benzene system the first

pair, 10.2 and 6.8 was copied correctly, but may be a typographical error for 6.8 and 10.2 in the original (even though not so plotted) since it is inconsistent with the other items and with an observation by the compiler. It would indicate a solutrope which probably does not exist.

The data of Trimble and Frazer (not Fraser) were reported in volume percentages. These were plotted and the extremities of three typical tie lines for each system were converted to gms. per 100 gms. solution as follows:

t^o	Lower Layer			Upper Layer		
	Glycol	Acetone	Benzene	Glycol	Acetone	Benzene
27	91.2	5.0	3.8	0.2	9.3	90.5
	80.6	12.2	7.2	1.5	23.0	75.5
	57.9	26.3	15.8	18.6	39.8	41.6
	Glycol	Acetone	Toluene	Glycol	Acetone	Toluene
27	83.0	12.1	4.9	1.2	22.3	76.5
	75.5	17.9	6.6	5.2	34.6	60.2
	67.1	24.0	8.9	12.3	42.4	45.3
	Glycol	Acetone	Xylene	Glycol	Acetone	Xylene
25	84.5	13.6	1.9	1.0	20.8	78.2
	76.7	19.8	3.5	2.0	33.0	65.0
	47.8	38.2	14.0	25.3	47.1	27.6
	Glycol	Acetone	Chloro-benzene	Glycol	Acetone	Chloro-benzene
23	82.6	12.6	4.8	1.0	17.6	81.4
	73.1	18.4	8.5	3.5	28.7	67.8
	61.0	24.8	14.2	12.5	37.7	49.8
	Upper Layer			Lower Layer		
	Glycol	Acetone	Bromo-benzene	Glycol	Acetone	Bromo-benzene
25	91.0	5.7	3.3	0.3	6.7	93.0
	81.3	12.8	5.9	0.6	14.4	85.0
	58.5	24.0	17.5	10.6	32.1	57.3
	Glycol Rich Layer			Glycol Poor Layer		
	Glycol	Acetone	Nitro-benzene	Glycol	Acetone	Nitro-benzene
22	77.0	13.0	10.0	2.0	16.3	81.7
	74.5	14.2	11.3	5.0	22.9	72.1
	57.9	22.2	19.9	15.6	30.6	53.8

The glycol rich layer is heavier in the first four systems, lighter in the bromobenzene system, and in the nitrobenzene system there is an isopycnic (dashed line) or tie line connecting compositions of equal density.



$C_2H_6O_4S$, Methyl Sulfate $(CH_3)_2SO_4$ - Aromatic Hydrocarbons - Paraffin Hydrocarbons.

(P. Pascal and M. L. Quinet, Compt. rend., 211, 193, 1940; Ann.chim. appl., 23, 5, 1941; Chem. Abstracts 36, 368, 3120). Gms. per 100 gms. liquid at 17°.

Lower Layer			Upper Layer		
Sulfate	Benzene	Heptane	Sulfate	Benzene	Heptane
91.6	5.5	2.9	7.0	8.2	84.8
82.2	12.6	5.2	8.9	19.2	71.9
75.9	16.1	8.0	11.8	28.3	59.9
68.3	22.0	9.7	14.6	32.0	53.4
60.2	26.9	12.9	24.4	39.7	35.9
42.0	44.0[a]	14.0[a]	Plait Point		

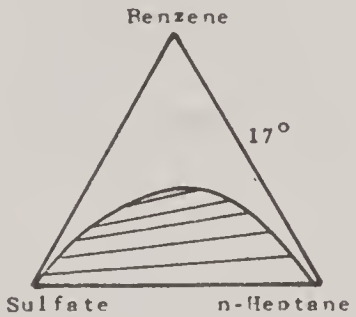
(a) To be consistent with the graph and the other values these figures should be 34.0 and 24.0 respectively.

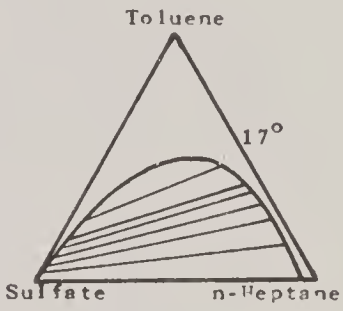
TERNARY NONAQUEOUS SYSTEMS

Lower Layer			Upper Layer		
Sulfate	Toluene	Heptane	Sulfate	Toluene	Heptane
92.0	5.9	2.1	5.2	10.1	84.9
86.9	10.2	2.9	3.6	20.5	75.9
83.4	12.4	4.2	3.4	28.1	68.5
76.7	18.5	4.8	3.5	36.4	60.1
74.0	20.9	5.7	3.5	39.7	56.8
61.0	28.7	10.3	5.0	48.5	46.5
34.0	43.0	23.0	Plait Point[b]		

(b) Francis (1950, p. 267) gave this point at 40, 40, 20%.

The densities and refractive indices of several binary systems of the aromatic hydrocarbons with methyl sulfate, n-pentane, n-hexane, and n-heptane, and also those of several ternary mixtures, all at 17° are given to aid in analysis of hydrocarbon mixtures.





METHYL SULFATE - Benzene - n-Heptane.

(Francis, 1950 p. 248). Compositions in gms. per 100 gms. liquid at 25°.

Lower Layer			Upper Layer		
Sulfate	Benzene	n-Heptane	Sulfate	Benzene	n-Heptane
98	0	2	0	0	100
87	9.5	3.5	1	13	86
71	22	7	4	25	71
65	25	10	6	35	59
54	32	14	13	41	46
37	40	23	Plait Point		

C_2H_7N, Ethyl Amine and Dimethyl Amine.

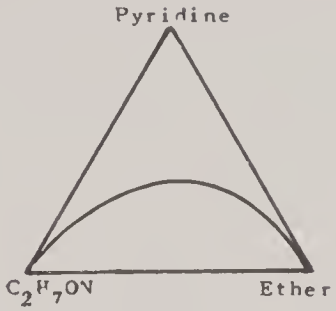
Distribution between acetone and glycerol (II 160-1).

TERNARY NONAQUEOUS SYSTEMS

C_2H_7ON, Ethanolamine, $HOC_2H_4NH_2$ - Ether - Pyridine.

(Siggia and Hanna, 1949).

The graph is shown but with no numerical data. The apex of the curve is at about 35% pyridine.



$C_3H_4O_4$, Malonic Acid and $C_3H_5O_2Br$, Bromopropionic Acid.

Distribution between acetone and glycerol (II 167, 169).

C_3H_6, Propylene. See sulfur dioxide - oropane; silver nitrate - propane.

C_3H_6O, Acetone. See methanol - gasoline; ethanol - gasoline; ethylene glycol - aromatics; aromatics or C_4 olefins; polystyrene-m-cresol or esters.

ACETONE.

Distribution between Acetone and Glycerol. (pages in Seidell II).

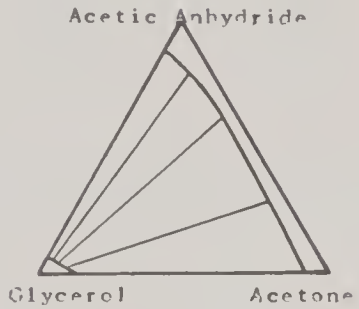
Acids		Page
HCOOH	Formic	31
$C_2HO_2Cl_3$	Trichloroacetic	68
$C_2H_2O_2Cl_2$	Dichloroacetic	78
$C_2H_3O_2Cl$	Chloroacetic	89
$C_2H_3O_2Br$	Bromoacetic	86
$C_2H_4O_2$	Acetic	114
C_2H_4OS	Thioacetic	118
$C_3H_4O_4$	Malonic	167
$C_3H_5O_2Br$	Bromopropionic	169
$C_3H_6O_2$	Propionic	191
$C_4H_4O_4$	Maleic:	216
$C_4H_4O_4$	Fumaric	216
$C_4H_5O_4Br$	Bromosuccinic	219
$C_4H_6O_4$	Succinic	229
$C_4H_6O_5$	Malic	233
$C_4H_6O_6$	Tartaric	236
$C_4H_8O_2$	n-Butyric	252
$C_4H_8O_2$	Isobutyric	252
$C_5H_8O_4$	Glutaric	293
$C_5H_{10}O_2$	Isovaleric	303
$C_7H_6O_5$	Gallic	533
$C_7H_7O_2N$	Anthranilic	540
$C_8H_6O_4$	o-Phthalic	574
$C_8H_8O_3$	Mandelic	594
$C_9H_9O_3N$	Hippuric	633

Acids		Page
C_2H_7N	Dimethyl Amine	160
C_2H_7N	Ethyl Amine	161
$C_4H_6O_3$	Acetic Anhydride	177
$C_4H_{11}N$	Diethyl Amine	278
$C_5H_{11}N$	Piperidine	308
$C_6H_{13}N$	Methylpiperidine	452
$C_6H_{15}N$	Dipropyl Amine	465
$C_6H_{15}N$	Triethyl Amine	467
$C_{13}H_{17}O_4N$	Piperidine Acid Phthalate	574
$C_{14}H_{19}O_4N$	N-Methylpiperidine Acid Phthalate	574
Acid Phthalates of following Amines		
$C_{10}H_{13}O_4N$	Dimethyl	213
$C_{11}H_{15}O_4N$	Trimethyl	213
$C_{12}H_{17}O_4N$	Diethyl	467
$C_{14}H_{21}O_4N$	Triethyl	467
$C_{14}H_{21}O_4N$	Dipropyl	466
$C_{16}H_{25}O_4N$	Diisobutyl	281
$C_{17}H_{19}O_4N$	Benzylethyl	642
$C_{17}H_{27}O_4N$	Tripropyl	466
$C_{18}H_{29}O_4N$	Diisoamyl	318

ACETONE - Glycerol - Acetic Anhydride (II 177).

Correction: The column headings are interchanged. They should have been in the order glycerol, acetone, acetic anhydride. The formula of the last should be $(CH_3CO)_2O$.

The compositions are given in mole percentages. They are recalculated to gms. per 100 gms. solution as follows:



Glycerol	Ac_2O	Acetone
92.25	7.75	0
92.1	4.4	3.5
90.5	2.15	7.35
9.9	90.1	0
7.2	80.9	11.9
5.9	61.4	32.7
8.1	27.8	64.1

ACETONE - Acetic Anhydride - Hexane, Petroleum Ether, or Gasoline.

(Mondain-Monval and Quiquarez, 1940, 1944). Effects of differences in refractive indices on opalescence.

$C_3H_6O_2$, Propionic Acid - Chloroform - Glycerol (II 193); Acetone - Glycerol (II 191).

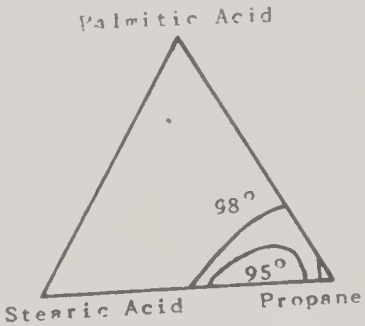
$C_3H_6O_3$, Lactic Acid, $CH_3CHOHCOOH$ - Ethanol - Benzene (II 141, ref.).

$C_3H_7O_2N$, Urethane, $NH_2COOC_2H_5$. See urea-phenacetin.

C_3H_8, Propane. See SO_2 - Propylene; $AgNO_3$ - Propylene.

PROPANE - Palmitic Acid - Stearic Acid.

(D. A. Drew and A. N. Hixon, Trans. Am. Inst. Chem. Engrs., 40, 687, 1944). Compositions in gms. per 100 gms. liquid.

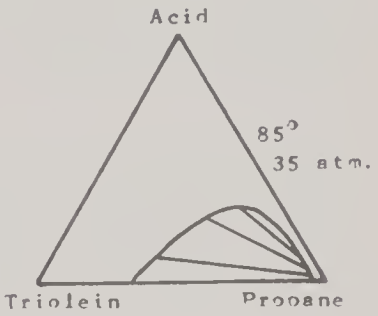


At 95°		At 98°	
Stearic	Palmitic	Stearic	Palmitic
44.4	0.0	47.5	0.0
23.3	14.6	29.0	17.2
13.3	10.2	10.0	27.2
10.6	7.7	0.0	33.0
7.2	3.4	0.0	6.5
5.4	1.8	1.7	4.7
6.8	0.0	3.1	0.0

PROPANE - Oleic Acid - Triolein.

(Hixson and Bockelmann, 1942). Compositions in gms. per 100 gms. at 85°.

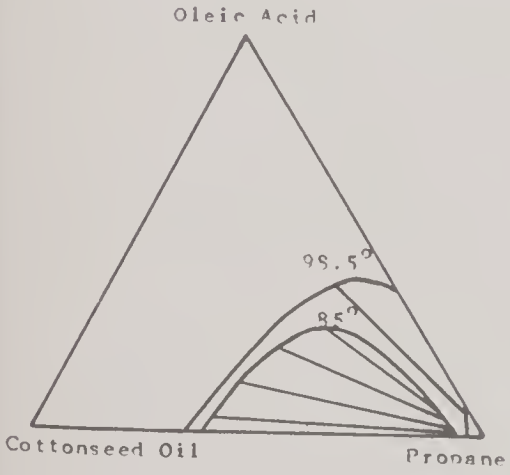
Lower Layer			Upper Layer		
Triolein	Acid	Propane	Triolein	Acid	Propane
67.7	0	32.3	3.8	0	96.2
53.0	11.6	35.4	2.6	1.6	95.8
36.1	23.2	40.7	2.3	4.4	93.3
20	30	50	2.8	9.6	87.6

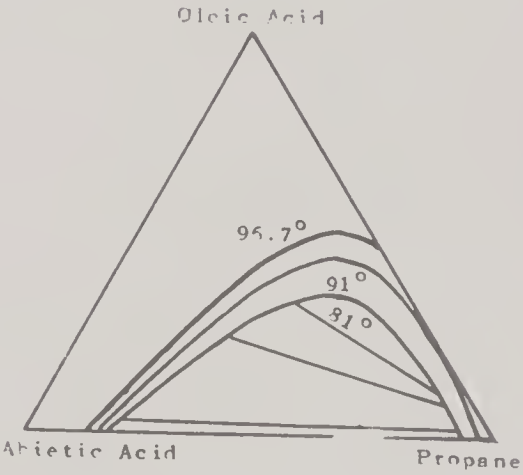


PROPANE - Oleic Acid - Refined Cottonseed Oil.

(Hixson and Bockelmann, 1942). Compositions in gms. per 100 gms. at 85° and 496 lbs. pressure, or at 98.5° and 625 lbs. pressure.

t°	Lower Layer			Upper Layer		
	Oil	Acid	Propane	Oil	Acid	Propane
85	59.0	0.2	40.8	4.2	0.03	95.8
	51.9	4.8	43.3	4.0	0.8	95.2
	39.8	12.5	47.7	4.2	2.6	93.2
	29.4	20.5	50.1	3.6	5.3	91.1
	17.3	25.7	57.0	4.1	9.7	86.2
	6.1	20.9	73.0	Plait Point		
98.5	63.5	0	36.5	2.3	0	97.7
	52.0	9.0	39.0	1.9	1.3	96.8
	39.8	18.7	41.5	1.2	2.4	96.4
	26.9	29.4	43.7	1.1	4.4	94.5
	14.2	37.4	48.4	0.8	6.1	93.5
	0.8	43.7	55.5	0.2	5.5	94.3



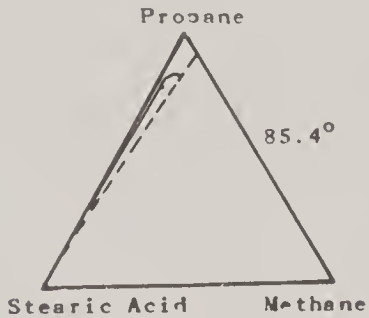


PROPANE - Oleic Acid - Abietic Acid.

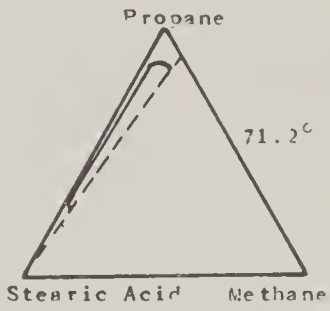
(A. W. Hixson and A. N. Hixson, Trans. Am. Inst. Chem. Engrs., 37, 927, 1941). Forty-five known mixtures of the three components were charged and the temperature of phase separation was observed as the temperature was raised. Interpolation of the data gave the isotherms shown on the diagram.

PROPANE - Methane - Stearic Acid or Trimyristin.

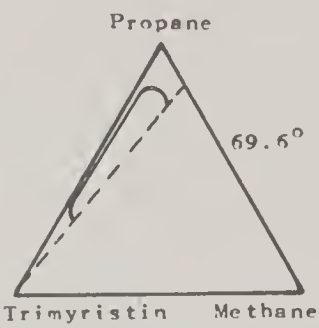
(R. Bogash and A. N. Hixson, Chem. Eng. Progress, 47, 347, 1951). Methane permits extraction with propane at lower temperatures and with control by means of pressure. Compositions in gms. per 100 gms. liquid. The dotted lines show the limit in composition of liquid hydrocarbon (critical compositions).



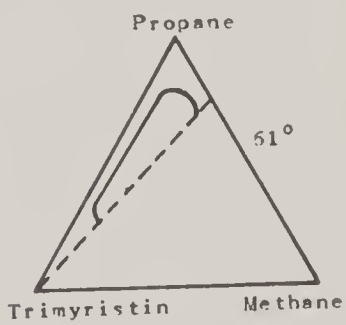
Stearic	Propane	Methane
3.7	92.6	3.7
18.3	80.2	1.5
32.4	66.4	1.2
50.6	47.6	1.8



Stearic	Propane	Methane
17.1	78.9	4.0
29.5	67.0	3.5
34.2	62.9	2.9



Trimyristin	Propane	Methane
4.0	91.4	4.6
17.5	80.0	2.5
42.8	55.5	1.7
57.5	40.5	2.0



Trimyristin	Propane	Methane
17.1	79.0	3.9
32.3	64.8	2.9
42.6	54.9	2.5

C_3H_8O, n-Propanol. See $ZnCl_2$ - picoline; formic acid - petroleum ether.

C_3H_8O, Isopropanol. See ethanol - gasoline; ethylene glycol - acetone - butadiene or isobutene.

$C_3H_8O_2$, β-Methoxyethanol or Methyl Cellosolve. See toluene-n-heptane; xylene - gasoline.

Distribution of formic acid (II 31), acetic acid (II 114), butyric acid (II 258), caprylic acid (II 620), lauric, myristic, palmitic, and oleic acids and β-methoxyethyl caprylate, laurate, palmitate, and oleate between β-methoxyethanol and isooctane (2,2,4-trimethylpentane). (Henriques, 1933).

$C_3H_8O_2$, Propylene Glycol - Benzene - Soaps.

(Palit and McBain, 1946). Six complex ternary diagrams.

$C_3H_8O_3$, Glycerol. See iodine - carbon tetrachloride, chloroform, ether, or benzene; ethanol-benzene; acetone-44 substances.

GLYCEROL - Isovaleric Acid - Nitrobenzene or Toluene.

Distribution of acid (II 306).

GLYCEROL - Nitrobenzene - Petroleum (b.p. 200-30°).

(Holmes, 1918). No numerical data, but the system forms three liquid layers above 17°.

$C_4H_2O_3$, Maleic Anhydride. See toluene-n-heptane.

$C_4H_4O_4$, Maleic and Fumaric Acids.

Distribution between acetone and glycerol (II 216); or acetonitrile and isooctane. (A. E. Smith and Norton, 1932)

C_4H_5NS, Allyl Isothiocyanate. See sulfur-aromatic amines.

$C_4H_5O_4Br$, Bromosuccinic Acid. Acetone - Glycerol (II 219).

C_4H_6, Butadiene. See methanol or furfural-isobutene.

$C_4H_6O_3$, Acetic Anhydride, $(CH_3CO)_2O$. See acetone-glycerol; toluene-n-heptane; xylene-gasoline.

$C_4H_6O_4$, Succinic Acid - Acetone - Glycerol (II 229).

$C_4H_6O_5$, Malic Acid - Acetone - Glycerol (II 233).

$C_4H_6O_6$, Tartaric Acid - Acetone - Glycerol (II 236).

C_4H_8, Isobutene. See methanol or furfural - butadiene.

$C_4H_8O_2$, n-Butyric Acid.

Distribution between methanol or methoxyethanol and isooctane (II 258); acetone and glycerol (II 252).

$C_4H_8O_2$, Isobutyric Acid - Acetone - Glycerol (II 252).

$C_4H_8O_2S$, Sulfolane, $CH_2CH_2SO_2CH_2CH_2$. See toluene - petroleum.

$C_4H_8O_3$, Ethylene Glycol Monoacetate or Cellosolve Acetate. See polystyrene - acetone.

$C_4H_{10}O$, n-Butanol. See 96% ethanol - gasoline; polystyrene - esters.

$C_4H_{10}O$, Isobutanol. See 96% ethanol - gasoline; zinc chloride - oicoline.

$C_4H_{10}O$, Ether. See 96% ethanol - gasoline; iodine - ethylene glycol or glycerol; ethanolamine - pyridine.

$C_4H_{11}N$, Diethylamine - Acetone - Glycerol (II 278); Methanol - Vaseline Oil (II 280).

$C_4H_{12}N_2S$, Di(β-aminoethyl) sulfide. See benzene - heptane.

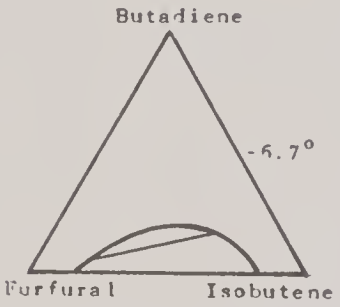
$C_4H_{13}N_3$, Di(β-aminoethyl) amine. See benzene-cyclohexane

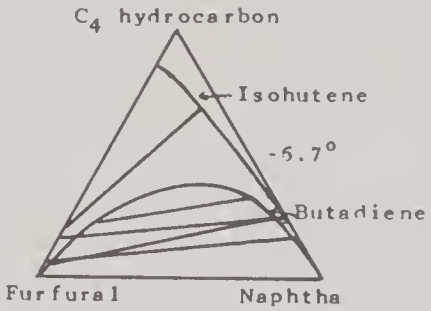
$C_5H_4O_2$, Furfural, See toluene - petroleum, xylene-gasoline.

FURFURAL - Butadiene - Isobutene.

(A. S. Smith and Braun, 1945). Compositions in gms. per 100 gms. liquid at -6.7°.

Lower Layer			Upper Layer		
Furfural	C_4H_6	C_4H_8	Furfural	C_4H_6	C_4H_8
82.1	0.0	17.9	15.9	0.0	84.1
72.3	7.1	20.6	22.0	17.0	61.0





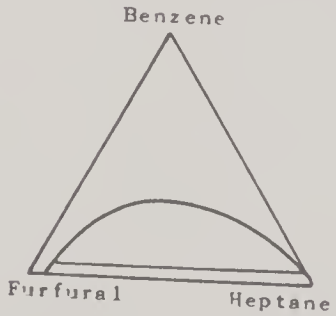
FURFURAL - Naphtha - Butadiene or Isobutene. Ibid.

Lower Layer			Upper Layer		
Furfural	C_4H_6	Naphtha	Furfural	C_4H_6	Naphtha
89.2	7.0	3.8	3.8	14.4	81.8
82.7	13.8	3.5	7.5	26.3	66.2
74.3	21.7	4.0	12.5	36.5	51.0
Furfural	C_4H_8	Naphtha	Furfural	C_4H_8	Naphtha
95.0	3.0	2.0	2.5	19.2	78.3
83.5	16.2	0.3	9.5	64.0	26.5

FURFURAL - Benzene - Heptane (presumably n-).

(Saunders, 1951). Compositions recalculated to gms. per 100 gms. liquid (temp. not given).

Furfural	Benzene	Heptane
91.9	0.0	8.1
87.6	4.1	8.3[a]
81.5	10	8.5
66.5	20	13.5
44.5	30	25.5
19.5	30	50.5
9.5	20	70.5
4.3	10	85.7
2.1	6.1	91.8[a]
0.8	0.0	99.2



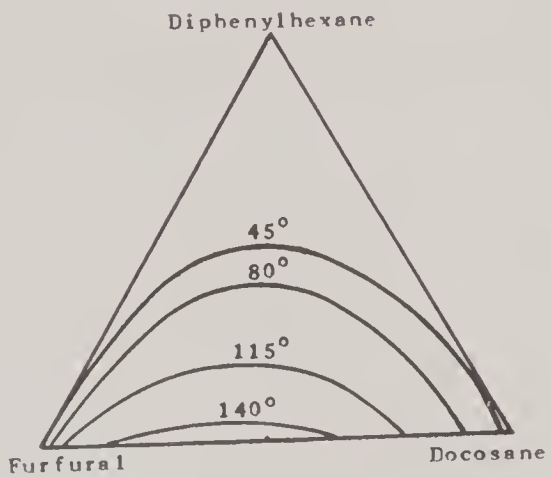
(a) Compositions in equilibrium.

FURFURAL - Diphenylhexane - Docosane.

(S. W. Briggs and E. W. Comings, Ind. Eng. Chem., 35, 411, 1943). Compositions in gms. per 100 gms. saturated liquid.

	Lower Layer			Upper Layer		
t°	Furfural	$PhC_6H_{12}Ph$	Docosane	Furfural	$PhC_6H_{12}Ph$	Docosane
45	99.3	0.0	0.7	4.0	0.0	96.0
	89.1	9.8	1.1	4.8	10.0	85.2
	73.6	24.2	2.2	6.5	24.5	69.0
	52.3	40.9	6.8	13.5	42.6	43.9
	30.0	48.7	21.3			
80	99.8	0.0	0.2	9.7	0.0	90.3
	79.6	15.8	4.6	13.0	13.9	73.1
	63.4	27.4	9.2	20.0	29.5	50.5
	40.0	36.2	23.8			
115	92.8	0.0	7.2	20.3	0.0	79.7
	83.4	6.7	9.9	23.7	6.3	70.0
	77.0	10.5	12.5	26.7	10.4	62.9
	50.0	17.8	32.2			
140	76.2	0.0	23.8	40.6	0.0	59.4
	60.0	2.5	37.5			
144.3	53.9	0.0	46.1	Critical Solution Temp.		

The isotherm at 80° is solutropic (with a horizontal tie line), and probably the others are also. Additional observations on compositions on the binodal curves are given.



C_5H_5N, Pyridine. See ethanolamine - ether.

$C_5H_6ON_2$, β-(Cyanomethoxy) propionitrile. See benzene - heptane.

$C_5H_6O_2$, Furfuryl Alcohol. See toluene - heptane; xylene - gasoline.

$C_5H_7N_3$ (Methylamino) Diacetonitrile } See benzene - heptane

$C_5H_7O_2N$ 2-Cyanoethyl Acetate

TERNARY NONAQUEOUS SYSTEMS

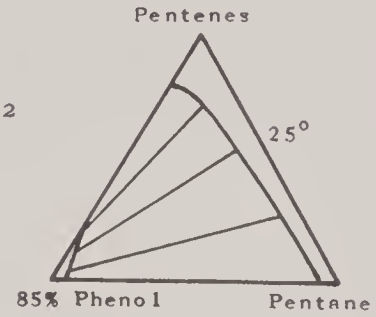
$C_5H_8O_4$, Glutaric Acid - Acetone - Glycerol (II 293).

C_5H_9ONS, β Cyanoethyl-β′ hydroxyethyl Sulfide
$C_5H_9O_2N$, β Cyanoethyl-β′ hydroxyethyl Ether
} See under benzene-heptane.

C_5H_{10}, Pentenes - Phenol - Pentane.

(Francis, 1950 p.245). The phenol contained 15% of water. Composition in gms. per 100 gms. liquid at 25°.

Lower Layer			Upper Layer		
85% Phenol	C_5H_{10}	C_5H_{12}	Phenol	C_5H_{10}	C_5H_{12}
82	18	0	24	76	0
85	14	1	13	65	22
87	10	3	9	48	43
93	3	4	5	22	73
96	0	4	5	0	95

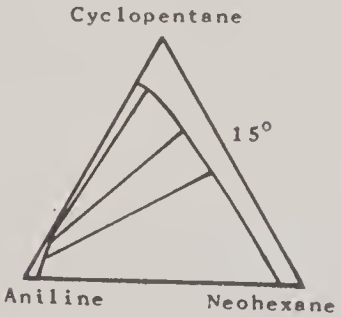


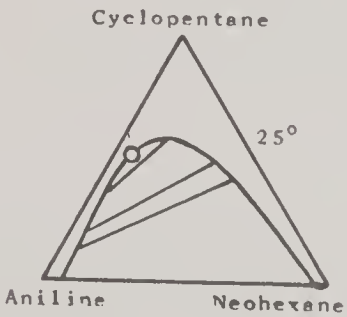
This binodal curve is not sharply defined because the water is not uniformly distributed with the phenol. It is really a quaternary system.

C_5H_{10}, Cyclopentane - Aniline - Neohexane.

(K. T. Serijan, R. A. Sourr, and L. C. Gibbons, J. Am. Chem. Soc., 68, 1763, 1946). Compositions in gms. per 100 gms. saturated solution.

t°	Lower Layer			Upper Layer		
	Aniline	C_5H_{10}	C_6H_{14}	Aniline	C_5H_{10}	C_5H_{12}
15	93.9	0.0	6.1	4.1	0.0	95.9
	89.7	5.4	4.9	7.0	39.0	54.0
	83.3	13.0	3.7	9.7	60.0	30.3
	75.2	23.4	1.4	16.4	76.5	7.1
25	91.9	0.0	8.1	6.2	0.0	93.8
	83.6	10.3	6.1	10.3	36.3	53.4
	80.5	13.9	5.6	12.3	45.7	42.0
	63.0	32.5	4.5	21.5	60.8	17.7
	37.8	54.5	7.7	Near Plait Point		





$C_5H_{10}ON_2$, β Cyanoethyl-β'-hydroxyethyl Amine. See under benzene-heptane.

$C_5H_{10}O_2$, n-Valeric Acid. Sulfuric Acid - Benzine (I 599, II 301); Methanol - Hexane (II 53, ref.); Nitrobenzene - Hexane (II 359, 458).

$C_5H_{10}O_2$, Isovaleric Acid - Chloroform - Glycerol (II 306); Acetone - Glycerol (II 303);

$C_5H_{11}N$, Piperidine - Acetone - Glycerol (II 308).

C_5H_{12}, n-Pentane. See pentenes - phenol.

C_5H_{12}, Petroleum Ether. See formic acid - alcohols; acetone - acetic anhydride.

$C_5H_{12}O$, Amyl Alcohol. See boric acid - glycerol; 95% ethanol - gasoline (II 152).

$C_5H_{12}O$, Isoamyl Alcohol - Zinc Chloride - Picoline (II 420).

$C_5H_{12}O_2$, Methyl Carbitol, $CH_3OCH_2CH_2OCH_2CH_2OH$. See xylene-gasoline.

$C_6H_3O_4N_2Cl$, 2,4-Dinitrochlorobenzene. See toluene-n-heptane.

$C_6H_4O_4N_2$, m-Dinitrobenzene. See nitrobenzene-hexane

C_6H_5Br, Bromobenzene and C_6H_5Cl, Chlorobenzene. See ethylene glycol-acetone.

$C_5H_5O_2N$, Nitrobenzene. See formamide-n-hexane; ethanol-ethylene glycol; glycerol-petroleum.

NITROBENZENE - Hexane - Butyric, Valeric, or Benzoic Acids, Resorcinol, or o-Nitrophenol (II 359, 458).

The effects of small percentages of the third components on the critical solution temperatures of nitrobenzene and hexane. The low values for this temperature indicate that the hexane probably contained naphthenes. The data are inadequate for plotting isotherms. Correction: The second item in column 1 for resorcinol should be 34.94 instead of 39.94.

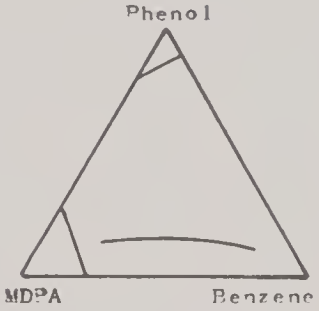
NITROBENZENE - Hexane - m-Dinitrobenzene, p-Nitrophenol, Hydroquinone, Resorcinol, p-Nitrobenzaldehyde, m-Nitrobenzoic Acid. (Timmermans, 1907).

$C_6H_5O_3N$, o- and p-Nitrophenols. See nitrobenzene - hexane.

C_6H_6, Benzene. See iodine - glycerol (I 669); sulfur dioxide - nonaromatic hydrocarbons; bromoform, formic acid; methanol (five systems); acetic acid - glycerol; ethanol (three systems); ethylene glycol - acetone; methyl sulfate - n-heptane; propylene glycol - soaps; furfural - heptane; aniline - nonaromatic hydrocarbons.

BENZENE - Phenol - m-Phenylene Diamine, $C_6H_4(NH_2)_2$ 'MPDA'

(Zhuravlev and Bychkova, 1947). Cf. the system water - phenol - m-phenylenediamine. Twenty observations on solution temperature of various ternary mixtures were reported. The binodal curve is an interpolation between these observations. The lines for composition of liquid in equilibrium with solid phenol (m.p. 41°) and m-phenylenediamine (m.p. 63°) are conjectural. The binary C.S.T. of benzene - m-phenylenediamine is 70.1°.



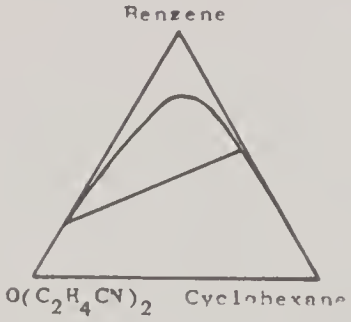
BENZENE - Cyclohexane - Polymethacrylic acid ester.

(Schulz and Jirgensens, 1940). Scattered data.

BENZENE - Cyclohexane - Three Nitriles.

(Saunders, 1951). ββ'Oxydipropionitrile or Di(β-cyanoethyl) ether, $O(C_2H_4CN)_2$. Compositions recalculated to gms. per 100 gms. saturated liquid (temp. not given).

$O(C_2H_4CN)_2$	Benzene	Cyclohexane
99.9	0	0.1
72.2	25	2.8
44.7	50	5.3
18	70	12.0
11.3	70	18.7
2.8	50	47.2
1.3	25	73.7
0.2	0	99.8



The tie line shown is constructed according to directions given in the paper.

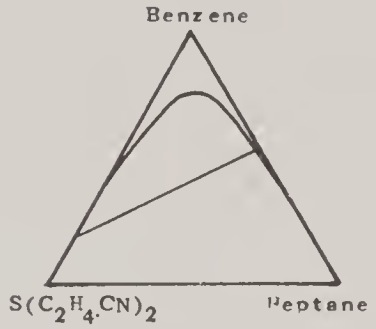
Data are presented also for ββ'imino-dipropionitrile and αα'thiodipropionitrile, which are very similar.

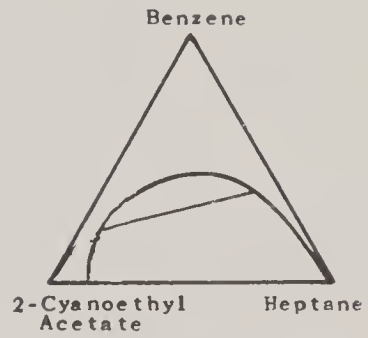
Data for the last two of these solvents, which are called di(βcyanoethyl) amine, and di(βcyanoethyl) sulfide, and also $C_4H_{13}N_3$, di(β-aminoethyl) amine are presented by Wilkes (1948) for extraction of benzene from cyclohexane.

BENZENE - Heptane - Ten Nitriles.

(Saunders, 1951). Compositions recalculated to gms. per 100 gms. saturated liquid (temp. not stated).

$S(C_2H_4CN)_2$	Benzene	Heptane	2-Cyanoethyl acetate	Benzene	Heptane
99.7	0.0	0.3			
74.0	25.0	1.0	87.5	0.0	12.5
47.5	50.0	2.5	78.0	15.0	7.0
25.3	70.0	4.7	63.5	30.0	6.5
18.7	75.0	6.3	29.0	45.0	26.0
3.5	75.0	21.5	13.5	45.0	41.5
1.8	70.0	28.2	3.8	30.0	66.2
0.3	50.0	49.7	1.8	15.0	83.2
0.1	0.0	99.9	0.1	0.0	99.9





The tie lines shown are constructed according to directions in the paper. Data are presented for eight other nitriles which are intermediate in height of curve between those of the two shown. The nitriles in descending order of height of curve are $C_6H_8SN_2$, $\beta\beta'$thiodipropionitrile (graph shown); $C_6H_9N_3$, $\beta\beta'$iminodipropionitrile; $C_6H_8ON_2$, $\alpha\beta'$oxydipropionitrile and $\beta\beta'$oxydipropionitrile; $C_8H_{11}ON_3$, NN-bis (2-cyanoethyl) acetamide; $C_5H_6ON_2$, β-(cyanomethoxy) propionitrile; $C_7H_{11}N_3$, $\beta\beta'$ (methylimino)dipropionitrile; $C_5H_7N_3$, (methylimino) diacetonitrile; $C_7H_{11}N$, β [(cyanomethyl) ethylamino] propionitrile; $C_5H_7O_2N$, 2 cyanoethyl acetate (graph shown).

Data on the first three of these same solvents, which are called di (βcyanoethyl) sulfide, di(β-cyanoethyl) amine, and di(β-cyanoethyl) ether, and also $C_4H_{12}N_2S$, di(β-aminoethyl) sulfide; $C_5H_9O_2N$, β-cyanoethyl-β'hydroxyethyl ether; $C_8H_{12}O_2N_2$, ethylene glycol di(β-cyanoethyl) ether; $C_{10}H_{16}O_3N_2$, diethylene glycol di(βcyanoethyl) ether; C_5H_9ONS, β cyanoethylβ'hydroxyethyl sulfide; and $C_5H_{10}ON_2$, β cyanoethyl β'hydroxyethyl amine, are presented by Wilkes (1948) for extraction of benzene from cyclohexane; of toluene from "troluoil", a mixture of heptanes and octanes; or for extraction of styrene from xylene or ethylbenzene. One or more distributions is given with each solvent.

C_6H_6O, Phenol. See pentenes - pentane; benzene - m-phenylenediamine.

$C_6H_6O_2$, Resorcinol. See sulfur - α Naphthyl Amine; urea - diphenyl Amine; nitrobenzene - hexane.

$C_6H_6O_2$, Hydroquinone or Quinol. See nitrobenzene - hexane.

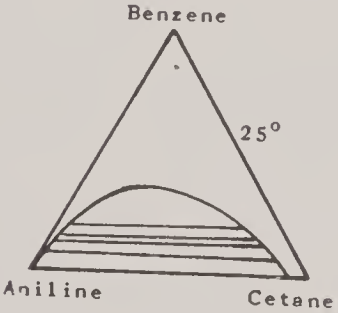
C_6H_7N, Aniline. See cyclopentane - neohexane; toluene - n-heptane; xylene - gasoline.

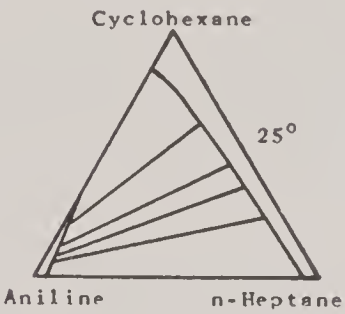
ANILINE - Acetic, Propionic, Butyric Acids. See aniline - cyclohexane.

ANILINE - Two Hydrocarbons.

(T. G. Hunter and T. F. Brown, Ind. Eng. Chem., 39, 1343, 1947). Compositions in gms. per 100 gms. saturated liquid at 25°.

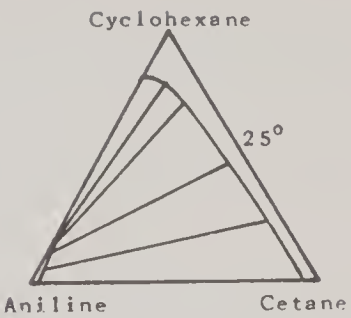
Lower Layer			Upper Layer		
Aniline	Benzene	Cetane	Aniline	Benzene	Cetane
97.7	0.0	2.3	6.3	0.0	93.7
89.7	8.0	2.3	7.2	6.2	86.6
85.8	11.6	2.6	8.2	10.3	81.5
81.2	15.5	3.3	9.4	14.8	75.8
75.2	20.1	4.7	11.4	19.6	69.0

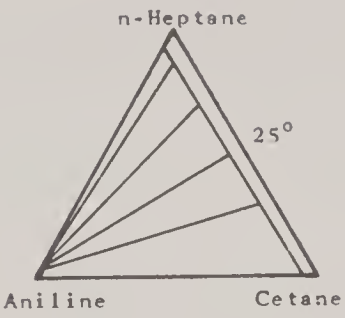




Lower Layer			Upper Layer		
Aniline	Cyclohexane	n-Heptane	Aniline	Cyclohexane	n-Heptane
93.5	0.0	6.5	6.6	0.0	93.2
92.5	1.5	6.0	8.1	18.4	73.5
90.5	4.1	5.4	9.3	31.4	59.3
88.9	6.2	4.9	10.4	41.8	47.8
83.9	12.7	3.4	13.0	61.4	25.6
73.8	26.2	0.0	16.5	83.5	0.0

Lower Layer			Upper Layer		
Aniline	Cyclohexane	Cetane	Aniline	Cyclohexane	Cetane
97.7	0.0	2.3	6.3	0.0	93.7
95.0	3.0	2.0	5.8	16.6	77.6
92.1	6.3	1.6	6.8	37.8	55.4
85.2	13.9	0.9	11.7	67.7	20.6
80.4	19.2	0.4	14.1	76.3	9.6
73.8	26.2	0.0	16.5	83.5	0.0





Lower Layer			Upper Layer		
Aniline	Heptane	Cetane	Aniline	Heptane	Cetane
97.7	0.0	2.3	6.3	0.0	93.7
97.0	1.7	1.3	6.3	27.7	72.0
96.3	2.9	0.8	6.3	35.4	58.3
95.1	4.6	0.3	6.2	57.8	36.0
94.0	5.8	0.2	6.4	78.7	14.9
93.5	6.5	0.0	6.8	93.2	0.0

ANILINE - Methylcyclopentane - n-Hexane.

(B. de B. Darwent and C. A. Winkler, J. Phys. Chem., 47, 449, 1943). Compositions recalculated to gms. per 100 gms. liquid at 25°, 34.5°, and 45°.

t°	Lower Layer			Upper Layer		
	Aniline	C_6H_{12}[a]	C_6H_{14}[a]	Aniline	C_6H_{12}	C_6H_{14}
25	92.4	0.0	7.6	7.5	0.0	92.5
	89.4	5.0	5.6	14.9	31.6	53.5
	85.7	10.8	3.5	11.4	60.7	27.9
	77.5	22.5	0.0	15.7	84.3	0.0
34.5	89.5	0.0	10.5	10.0	0.0	90.0
	84.9	7.4	7.7	13.7	32.6	53.7
	80.2	14.5	5.3	16.8	56.9	26.3
	75.4	21.1	3.5	25.8	67.6	6.6
	48.5	51.5[b]	0.0	Plait Point[c]		
45	87.2	0.0	12.8	14.8	0.0	85.2
	82.9	5.1	12.0	15.4	13.6	71.0
	81.0	7.2	11.8	18.4	29.1	52.5
	68.9	19.7	11.4	28.0	42.6	29.4

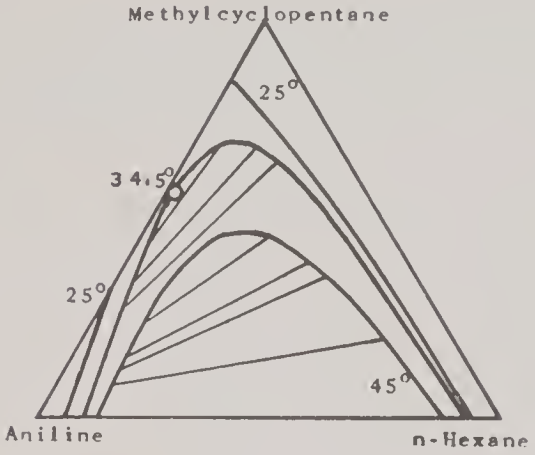
(a) In table IV of the original these headings are interchanged. Consolute lines "A" and "B" shown in the original triangular graphs seem to be interchanged.

(b) In Table IV this is given as "0.640 mole fraction" but in Tables I and II and Figures 1, 4, 8 it is "0.540" or 51.5% by wt.

(c) Also critical solution point of aniline-methylcyclopentane.

TERNARY NONAQUEOUS SYSTEMS

ANILINE - Methylcyclopentane - n-Hexane (cont.).



ANILINE - Benzene - Cyclohexane.

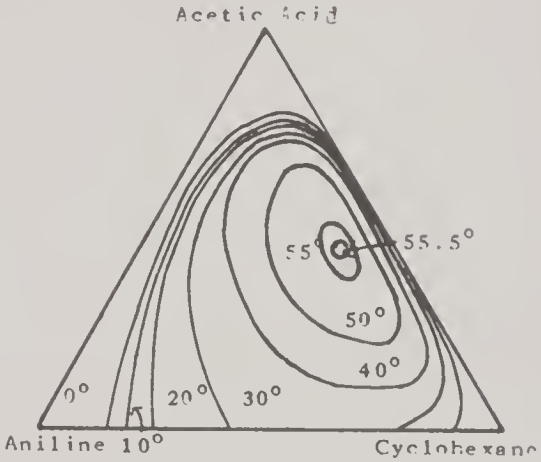
(H. Schlegal, J. chim. phys., 31, 519, 1934; Tizard and Marshall, 1921). Effect of benzene on the critical solution temperature of aniline - cyclohexane.

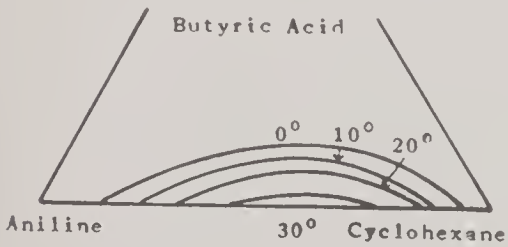
ANILINE - Gasoline - Benzene, Toluene, or Xylene.

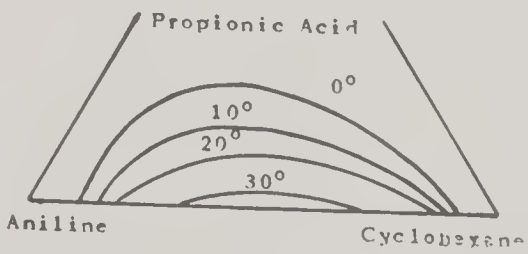
(Tizard and Marshall, 1921). Effect of aromatics on critical solution temperature of aniline - gasoline.

ANILINE - Cyclohexane - Fatty Acids.

(E. Angelescu and R. Giusca, Z. phys. Chem., A191, 145, 1942). The mixing temperature of 83 compositions of the acetic acid system in gms. per 100 gms. mixture were observed and the isotherms constructed by interpolation. The simpler systems with the higher acids were determined similarly with 19 and 16 observations respectively.

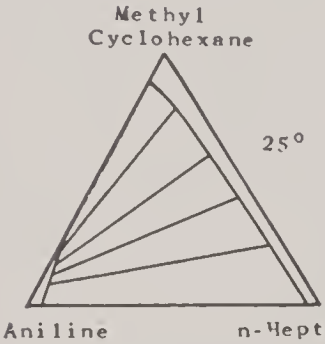






ANILINE - Methylcyclohexane - n-Heptane.

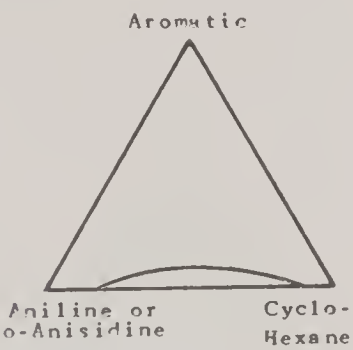
(K. A. Vartaressian and M. R. Fenske, Ind. Eng. Chem., 29, 270, 1937).
Gms. per 100 gms. liquid at 25°.

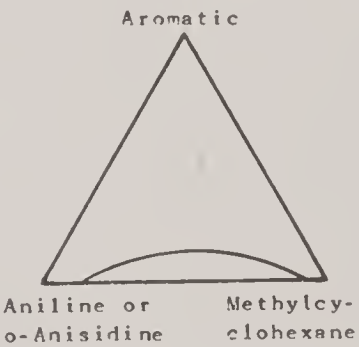


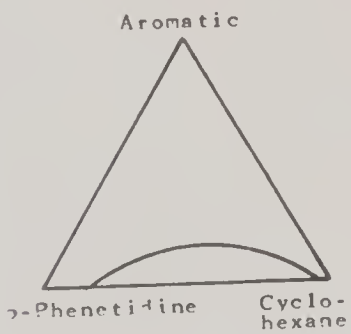
Lower Layer			Upper Layer		
Aniline	C_7H_{14}	C_7H_{16}	Aniline	C_7H_{14}	C_7H_{16}
93.8	0.0	6.2	7.4	0.0	92.6
92.0	2.7	5.3	8.0	18.6	73.4
90.0	6.0	4.0	8.7	40.9	50.4
88.0	9.2	2.8	9.6	59.7	30.7
85.5	13.1	1.4	10.4	73.6	16.0
83.1	16.9	0.0	11.9	88.1	0.0

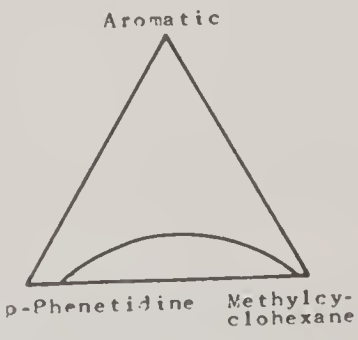
AROMATIC AMINE - Aromatic Hydrocarbon - Nonaromatic Hydrocarbon.

Angelescu and coworkers (1942-4) investigated 75 systems in which the amine was aniline, o-anisidine, or p-phenetidine; the nonaromatic hydrocarbon was cyclohexane, methylcyclohexane, or isooctane (2,2,4-trimethylpentane); and the aromatic hydrocarbon was benzene, toluene, ethylbenzene, each of the xylenes, biphenyl, naphthalene, or tetralin. Mixing temperatures were observed for 10 to 28 mixtures in each system and coordinates were presented for an isotherm at 20° for each of 54 systems, which include all possibilities with the first six of the aromatics mentioned. These were all shallow curves nearly independent of the aromatic hydrocarbon.









TERNARY NONAQUEOUS SYSTEMS

AROMATIC AMINES

The following table presents data for plotting each of the 54 systems with fair precision, namely the extremities of the binodal curves (which are uniform for each group of six aromatic hydrocarbons) and its altitude or maximum percentage of aromatic hydrocarbon.

Aniline Systems (Angelescu and Zinca, 1942).

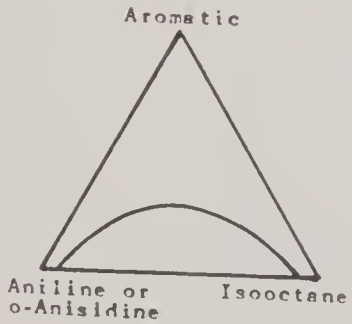
		Cyclohexane	Methylcyclohexane	Isooctane
Ends of curve % Aniline	0% Aromatic	78.90	85.61	94.66
		13.10	8.54	4.70
Maximum percent of: Benzene		5.93	10.71	27.24
Toluene		6.57	11.36	26.99
Ethylbenzene		6.43	12.48	28.54
o-Xylene		6.08	11.48	29.49
m-Xylene		6.46	13.14	28.97
p-Xylene		6.86	13.04	27.96

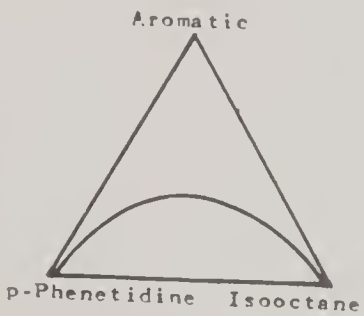
o-Anisidine Systems (Angelescu and Manolache, 1943).

		Cyclohexane	Methylcyclohexane	Isooctane
Ends of curve % o-Anisidine	0% Aromatic	80.18	84.23	94.01
		14.64	15.40	9.23
Maximum % of: Benzene		6.59	8.31	24.66
Toluene		6.27	8.81	24.64
Ethylbenzene		7.48	10.00	26.08
o-Xylene		7.04	10.22	25.32
m-Xylene		7.09	10.30	25.86
p-Xylene		7.13	10.72	26.15

p-Phenetidine Systems (Angelescu and Ciplea, 1943, 1944).

		Cyclohexane	Methylcyclohexane	Isooctane
Ends of curve % p-Phenetidine	0% Aromatic	84.15	87.98	94.65
		4.51	4.07	2.87
Maximum % of: Benzene		13.59	16.48	31.96
Toluene		15.02	17.99	31.93
Ethylbenzene		16.79	20.10	33.92
o-Xylene		15.57	18.73	33.25
m-Xylene		16.80	22.65	34.32
p-Xylene		16.91	21.47	34.84





TERNARY NONAQUEOUS SYSTEMS

AROMATIC AMINES

In the cyclohexane systems the partition coefficients or mean ratios of aromatic hydrocarbon content in the cyclohexane layer to that in the amine layer are given as follows:

	Partition Coefficients		
	Aniline	o-Anisidine	p-Phenetidine
Benzene	1.18	1.59	1.31
Toluene	1.66	2.14	1.46
Ethylbenzene	1.67	2.17	1.68
o-Xylene	1.66	2.00	1.51
m-Xylene	1.72	2.28	1.65
p-Xylene	1.66	2.10	1.68

In the following table are given the critical solution temperatures of amine and nonaromatic hydrocarbon, and the specific lowering of this temperature caused by 1% of aromatic hydrocarbon.

	Cyclohexane	Methylcyclohexane	Isooctane
Aniline, C.S.T.	30.9°	40.9°	79.4°
Benzene	1.890	1.825	2.067
Toluene	1.885	1.852	2.100
Ethylbenzene	1.737	1.711	2.043
o-Xylene	1.817	1.800	2.100
m-Xylene	1.682	1.710	1.966
p-Xylene	1.717	1.622	1.943
Biphenyl	1.531	1.503	1.520
Naphthalene	1.621	1.422	1.627
Tetralin	1.513		

	Cyclohexane	Methylcyclohexane	Isooctane
o-Anisidine, C.S.T.	31.4°	36.5°	77.0°
Benzene	2.04	2.05	2.26
Toluene	1.86	1.94	2.42
Ethylbenzene	1.75	1.81	2.30
o-Xylene	1.80	1.85	2.35
m-Xylene	1.80	1.77	2.32
p-Xylene	1.80	1.77	2.26
Biphenyl	1.45	1.49	1.53
Naphthalene	1.55	1.57	1.72
Tetralin	1.56		
p-Phenetidine, C.S.T.	44.7°	52.2°	90.4°
Benzene	1.88	1.92	2.25
Toluene	1.80	1.83	2.20
Ethylbenzene	1.70	1.68	2.00
o-Xylene	1.75	1.78	2.15
m-Xylene	1.72	1.68	2.06
p-Xylene	1.62	1.68	2.00
Biphenyl	1.44	1.58	1.64
Naphthalene	1.55	1.66	1.83
Tetralin	1.50		

TERNARY NONAQUEOUS SYSTEMS

AROMATIC AMINES

The graphs for biphenyl (m.p. 70.5°) and naphthalene (m.p. 80°) are complicated by curves for composition of liquid in equilibrium with crystals. When such a curve intersects the binodal curve, three phases, a solid and two liquids are in equilibrium. Angelescu and coworkers denote such a relation as a "peritechtic point". Actually the three phases can exist together over a temperature range. Presumably the maximum temperature for such relations is meant, so that the peritechtic point is the temperature at which the curve for solid phases intersects the plait point as shown in the graphs, which are largely conjectural.

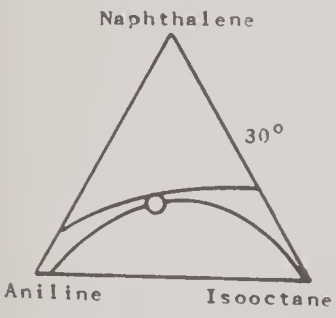
Peritechtic Points in Naphthalene Systems

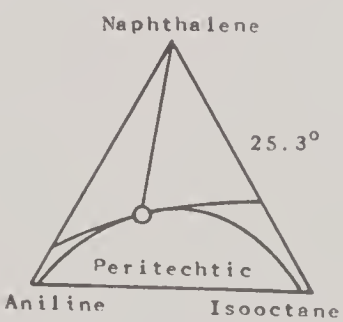
Compositions in gms. per 100 gms. liquid.

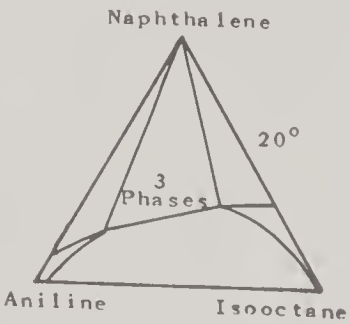
	t°	Amine	Naphthalene	Nonaromatic
Aniline				
Cyclohexane	2.95	39.0	16.9	44.1
Methylcyclohexane	6.0	37.3	20.8	41.9
Isooctane	25.3	35.3	31.9	32.8
o-Anisidine				
Cyclohexane	0.9	40.5	19.0	40.5
Methylcyclohexane	2.3	39.6	20.8	39.6
Isooctane	25.2	38.0	29.5	32.5
p-Phenetidine				
Cyclohexane	11.4	39.5	21.0	39.5
Methylcyclohexane	15.0	34.2	21.8	44.0
Isooctane	34.4	31.7	29.6	38.7

Peritechtic Points in Biphenyl Systems

	t°	Amine	Biphenyl	Nonaromatic
Aniline				
Cyclohexane	< -3.4	-	-	-
Methylcyclohexane	0.9	36.4	22.6	41.0
Isooctane	19.6	31.8	38.4	29.8
o-Anisidine				
Cyclohexane	< 0.9	-	-	-
Methylcyclohexane	2.1	38.6	23.2	38.2
Isooctane	21.7	34.8	35.8	29.4
p-Phenetidine				
Cyclohexane	8.0	No composition given		
Methylcyclohexane	< 11.8	-	-	-
Isooctane	28.3	28.4	37.4	34.2







C_5H_8N, m-Phenylene Diamine $C_6H_4(NH_2)_2$. See benzene - phenol.

C_5H_8N, Picolin, Methylpyridine. See $ZnCl_2$ - seven alcohols (II 420).

$C_5H_8ON_2$, $\beta\beta'$Oxydipropionitrile or Di(β-cyanoethyl) ether. See benzene-cyclohexane or n-heptane.

$C_5H_8N_2S$, $\beta\beta'$Thiodipropionitrile or Di(β-cyanoethyl) sulfide. See benzene - cyclohexane or n-heptane.

$C_5H_9N_3$, $\beta\beta'$Iminodiprooionitrile or Di(β-cyanoethyl) amine. See benzene - cyclohexane or n-heptane.

C_5H_{10}, Methyloentadiene. See methanol - ethylene glycol.

C_6H_{12}, Methylcyclopentane. See aniline - n-hexane.

C_6H_{12}, Cyclohexane. See methanol - ethylene glycol; acetic acid - acetic anhydride or aniline; benzene - nitriles or oolymethacrylic acid ester; aniline - fatty acids, n-heotane, cetane, benzene and other aromatics.

$C_6H_{12}O$, Cyclohexanol. See 96% ethanol - gasoline.

$C_6H_{12}O_2S$, 2,4-Dimethylsulfolane. See toluene - gasoline.

$C_5H_{13}N$, Methylpiperidine - Acetone - Glycerol (II 452).

C_6H_{14}, n-Hexane. See formamide - nitrobenzene; methanol - fatty acids; methyl sulfate - aromatic hydrocarbons; nitrohenzene - ten substances.

C_6H_{14}, Neohexane, 2,2-Dimethylbutane. See cyclopentane - aniline.

$C_6H_{14}O_4$, Triethylene Glycol. See toluene - n-heptane.

$C_6H_{15}N$, Dipropyl Amine or Triethyl Amine - Acetone - Glycerol (II 455-7).

$C_6H_{15}O_3N$, Triethanolamine. See methanol - butadiene or isobutene.

$C_7H_5NO_3$ - p-Nitrobenzaldehyde. See nitrobenzene - hexane.

TERNARY NONAQUEOUS SYSTEMS

$C_7H_5NO_4$ - m-Nitrobenzoic Acid. See nitrobenzene - hexane.

$C_7H_6O_2$. Benzoic Acid. See nitrobenzene - hexane.

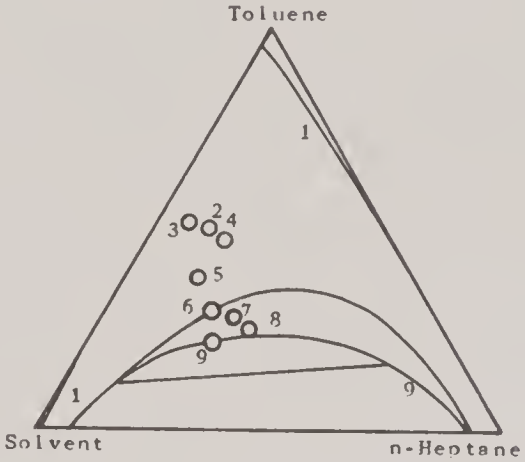
$C_7H_6O_5$. Gallic Acid - Acetone - Glycerol (II 533).

$C_7H_7O_2N$. Anthranilic Acid $NH_2C_5H_4COOH$ (o-)-Acetone - Glycerol (II 540).

C_7H_8. Toluene. See SO_2 - octane or kerosene; $SbCl_3$ - petroleum; methanol-ethylene glycol; acetic acid - heptane; ethanol - ethylene glycol; ethylene glycol - acetone; glycerol - isovaleric acid; nitriles - 'troluoil' (under benzene); aniline - gasoline; aniline, o-anisidine, or p-phenetidine with nonaromatic hydrocarbons.

TOLUENE - n-Heptane - Solvents. (Francis, 1950, p. 267).

Nine systems were presented, three of them with binodal curves and the other six with the plait point only. Compositions in gms. per 100 gms. liquid, at 25° except where otherwise noted.



No.	Solvent	%	Toluene	Heptane	
1	Triethylene Glycol	3	97	0	
1	" "	90	10	0	
1	" "	99	0	1	
2	Furfuryl Alcohol	41	44	15	P.P.
3	Maleic Anhydride (60°)	46	44	10	P.P.
4	Methyl Sulfate	40	40	20	P.P.
5	Dinitrochlorobenzene (55°)	47	33	20	P.P.
6	Carbitol[a]	46	26	28	P.P.
6	" (conjugate	94	0	6	
6	" phases)	6	0	94	
7	β Methoxyethanol	45	24	31	P.P.
8	Acetic Anhydride	44	20	36	P.P.
9	Aniline	50	19	31	P.P.
9	" (conjugate	78	10	12	
9	" phases)	18	15	67	
9	" (conjugate	91	0	9	
9	" phases)	9	0	91	

(a) Diethylene Glycol Monoethyl Ether.

P.P. = Plait Point.

TOLUENE - Petroleum Fraction - Solvent.

(H. G. Staarterman, R. C. Morris, R. M. Stager, and G. J. Pierott, Chem. Eng. Progress, 43, 148, 1947). Several solvents were tried for solvent concentration of toluene in a saturated petroleum fraction of comparable boiling range.

Solvent	t°	Wt. % Toluene (solvent free basis)	
		Raffinate	Extract
Sulfolane, CH_2-CH_2 / \ CH_2CH_2 > SO_2	20	8.3	68.5
	20	20.0	84.9
	20	20.0	91.4
2,4-Dimethylsulfolane	20	6.9	25.4
Furfural	20	7.9	34.7
Sulfur Dioxide	14	21.5	68.5
Antimony Chloride		9.4	57.0

C_7H_8O, m-Cresol. See polystyrene - acetone.

$C_7H_8O_2N_4$, Theobromine and Theophylline. (II 552).

Distribution between horse serum and olive oil.

C_7H_9N, Methylaniline and o-Toluidine. See sulfur - allyl isothiocyanate.

C_7H_9ON, o-Anisidine - Aromatic Hydrocarbons - Nonaromatic Hydrocarbons. Listed under aniline.

$C_7H_{11}N_3$, β(Cyanomethyl) ethylamino propionitrile. See benzene - n-heptane

$C_7H_{11}N_3$, $\beta\beta'$(Methylimino) dipropionitrile. See benzene - n-heptane.

C_7H_{14}, Methylcyclohexane. See aniline, o-anisidine, or p-phenetidine with aromatic hydrocarbons.

$C_7H_{14}O_2$, Heptoic Acid. See methanol - hexane.

C_7H_{16}, n-Heptane. See acetic acid - toluene; methyl sulfate - benzene or toluene; furfural - benzene; benzene - nitriles; aniline - cyclohexane or methylcyclohexane; toluene - nine solvents.

BENZINE or GASOLINE. See sulfuric acid - valeric acid; phosphoric or sulfuric acids - camphor; methanol - acetone or benzene; 96% ethanol-11 solvents; acetone - acetic anhydride; aniline - aromatic hydrocarbons; toluene - 5 solvents; xylene - 9 solvents.

$C_7H_{16}O_4S_2$ - Sulfonal.

Distribution between horse serum and olive oil. (II 568)

$C_8H_6O_4$, o-Phthalic Acid - Acetone - Glycerol (II 574).

PHTHALIC ACIDS. See acetonitrile - isooctane

C_8H_8, Styrene. See nitriles - ethylbenzene (listed under benzene).

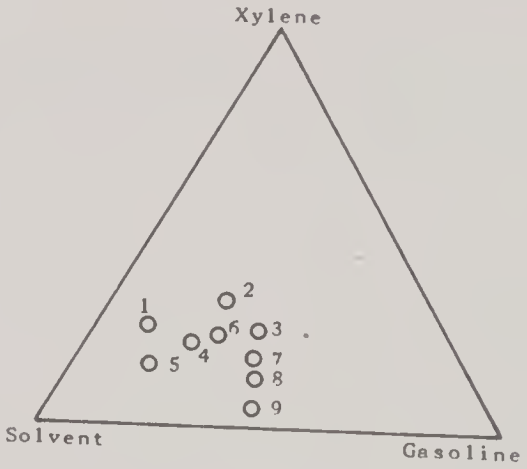
$C_8H_8O_3$, Mandelic Acid - Acetone - Glycerol (II 594).

C_8H_{10}, Ethylbenzene. See nitriles - styrene (listed under benzene); aniline, o-anisidine, or p-phenetidine with nonaromatic hydrocarbons.

C_8H_{10}, Xylenes. See methanol - ethylene glycol; ethanol - ethylene glycol; ethylene glycol - acetone; nitriles - styrene (listed under benzene); aniline, o-anisidine, or p-phenetidine with nonaromatic hydrocarbons.

XYLENES - GASOLINE - Nine solvents. (Francis, 1950, p. 268).

The gasoline was straight run with aniline point 30°C. Nine systems were presented by plait point only. Compositions of plait points are given in gms. per 100 gms. liquid.



Plait Points

No.	Solvents	%	Xylene	Gasoline
1	Methyl Carbitol	60	31	9
2	Furfuryl Alcohol	42	35	23
3	Furfural	39	26	35
4	β Chloroethanol	55	21	24
5	Aldol	65	16	19
6	Carbitol	46	25	29
7	β Methoxyethanol	43	39	18
8	Acetic Anhydride	45	41	14
9	Aniline	50	5	45

$C_8H_{10}O_2N_4$ Caffeine.

Distribution between horse serum and olive oil (II 613).

$C_8H_{11}N$, Dimethylaniline. See sulfur - allyl isothiocyanate.

$C_8H_{11}ON$, p-Phenetidine. See aromatic hydrocarbons - nonaromatic hydrocarbons (listed under aniline).

$C_8H_{11}ON_3$, NN-Bis (2-cyanoethyl) acetamide. See benzene - heptane.

$C_8H_{12}O_2N_2$, Ethylene Glycol Di(β-cyanoethyl) Ether. See under benzene - heptane.

$C_8H_{12}O_6$, Diethyl Tartrate. See formamide - ethylene dibromide.

C_8H_{16}, Octenes. See methanol - ethylene glycol.

$C_8H_{16}O_2$, Caprylic Acid. Methanol - Isooctane (II 620). βMethoxy ethanol-Isooctane (II 620).

C_8H_{18}, Isooctane or 2,2,4-Trimethylpentane. See methanol - formic acid and five other fatty acids; methoxyethanol with eight fatty acids and four of their esters; aniline, o-anisidine, or p-phenetidine with aromatic hydrocarbons.

$C_8H_{18}O$, Methyl Hexyl Carbinol. See $ZnCl_2$ - Picoline.

$C_8H_{18}O$, n-Butyl Ether. See polystyrene - esters.

$C_8H_{18}O_4S_2$, Trional. $C_2H_5CH_3C(SO_2C_2H_5)_2$.

Distribution between horse serum and olive oil (II 622).

$C_9H_9O_3N$, Hippuric Acid - Acetone - Glycerol (II 633).

$C_9H_{18}O_2$, Methyl Caprylate. See methanol - isooctane.

$C_{10}H_8$, Naphthalene - Methanol - Vaseline Oil (II 650). See aniline, o-anisidine, or p-phenetidine - nonaromatic hydrocarbons.

$C_{10}H_9N$, α-Naphthyl Amine. See sulfur - resorcinol..

$C_{10}H_{12}$, Tetralin. See cyclohexane - aniline, o-anisidine, or p-phenetidine (listed under aniline); $\beta\beta'$oxydipropionitrile - β-methyl-naphthalene.

$C_{10}H_{12}O_2$, Phenacetin. See urea - urethane.

$C_{10}H_{13}O_4N$, Dimethyl Amine Acid Phthalate - Acetone - Glycerol (II 213).

$C_{10}H_{14}O_3N_4$ Ethoxycaffeine.

Distribution between olive oil and horse serum (II 613).

$C_{10}H_{16}O$, Camphor. See phosphoric or sulfuric acid - ligroin; methanol - vaseline oil (II 679).

$C_{10}H_{16}O_3N_2$, Diethylene Glycol Di(β-cyanoethyl) Ether. Listed under benzene - heptane.

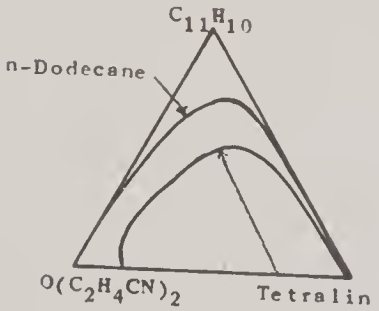
$C_{10}H_{18}O$, Terpineol. See 95% ethanol - gasoline.

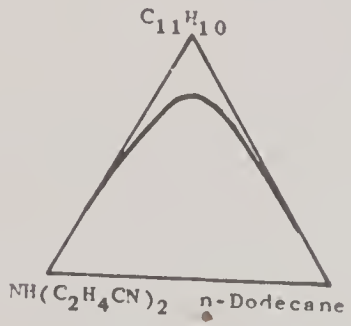
PARAFFIN OIL (mostly decanes). See ethanol - salts.

$C_{11}H_{10}$, β Methylnaphthalene - $\beta\beta'$-Oxydipropionitrile - Tetralin or n-Dodecane.

(Saunders, 1951). Compositions in gms. per 100 gms. liquid (temp. not stated).

$O(C_2H_4CN)_2$	$C_{11}H_{10}$	Tetralin	$O(C_2H_4CN)_2$	$C_{11}H_{10}$	n-Dodecane
82	0	18	99.9	0	0.1
74.5	15	10.5	74.3	25	0.7
59	30	11	48.0	50	2.0
37.5	45	17.5	19.0	70	11.0
9.5	45	45.5	5.5	70	24.5
4.5	30	65.5	0.9	50	49.1
3	15	82	0.1	0	99.9
1.9	0	98.1			





β-Methylnaphthalene - ββ'Iminodipropionitrile - n-Dodecane.

(Saunders, 1951).

$NH(C_2H_4CN)_2$	$C_{11}H_{10}$	n-Dodecane	$NH(C_2H_4CN)_2$	$C_{11}H_{10}$	n-Dodecane
99.9	0	0.1	3.7	70	26.3
73.0	25	2.0	1.7	50	48.3
46.0	50	4.0	1.4	25	73.6
22.2	70	7.8	1.0	0	99.0

$C_{11}H_{16}O$, Butylcresol. See 96% ethanol - gasoline.

$C_{11}H_{12}ON_2$, Antipyrene. See urea - sulfonal.

$C_{11}H_{15}O_4N$, Trimethyl Amine Acid Phthalate - Acetone - Glycerol (II 213).

$C_{11}H_{22}O_2$, β Meth oxyethyl Caprylate. See β methoxyethanol - isooctane.

$C_{12}H_{10}$, Biphenyl. See aniline, o-anisidine or p-phenetidine with cyclohexane, methylcyclohexane or isooctane.

$C_{12}H_{16}O_2$, Isoamyl Benzoate. See polystyrene - ethyl laurate.

$C_{12}H_{17}O_4N$, Diethyl Amine Acid Phthalate - Acetone - Glycerol (II 467).

$C_{12}H_{24}O_2$, Lauric Acid. See methanol - isooctane; acetonitrile - isooctane; methoxyethanol - isooctane.

$C_{12}H_{26}$, n-Dodecane. See β-Methylnaphthalene - nitriles.

$C_{13}H_{17}O_4N$, Piperidine Acid Phthalate - Acetone - Glycerol (II 574).

$C_{13}H_{25}O_2$, Methyl Laurate. See methanol - isooctane; polystyrene - n-butanol.

$C_{13}H_{28}$(approx.) Petroleum. See glycerol - nitrobenzene.

$C_{14}H_{12}O_2$, Benzyl Benzoate. See polystyrene - acetonitrile.

$C_{14}H_{14}O$, Benzyl Ether. See polystyrene - ethanol.

$C_{14}H_{19}O_4N$, N-Methylpiperidine Acid Phthalate - Acetone - Glycerol (II 574).

TERNARY NONAQUEOUS SYSTEMS

$C_{14}H_{21}O_4N$, Acid Phthalates of Triethyl Amine or Di-n-propyl Amine.- Acetone - Glycerol (II 466-7)

$C_{14}H_{28}O_2$, Ethyl Laurate. See polystyrene - n-butanol or propyl laurate.

$C_{14}H_{28}O_2$, Myristic Acid. See methoxyethanol - isooctane.

$C_{15}H_{30}O_2$, n-Propyl Laurate. See polystyrene - acetone, butyl ether, or esters.

$C_{15}H_{30}O_3$, β Methoxyethyl Laurate. See β-methoxyethanol - isooctane.

$C_{15}H_{25}O_4N$, Diisobutyl Amine Acid Phthalate - Acetone - Glycerol (II 281).

$C_{16}H_{32}O_2$, Palmitic Acid. See methanol - isooctane or palm oil; methoxyethanol - isooctane; propane - stearic acid.

$C_{16}H_{34}$, Cetane. See aniline - benzene or n-heptane or cyclohexane.

$C_{16}H_{34}O$, Cetyl Alcohol. See $ZnCl_2$ - picoline.

$C_{17}H_{19}O_4N$, Benzyl Ethyl Amine Acid Phthalate - Acetone - Glycerol (II 642).

$C_{17}H_{27}O_4N$, Trioropyl Amine Acid Phthalate - Acetone - Glycerol (II 465).

$C_{17}H_{34}O_2$, Methyl Palmitate. See methanol - isooctane.

$C_{18}H_{18}O_4N_2$, Salipyrine. See urea - sulfonal.

$C_{18}H_{22}$, Diphenylhexane. See furfural - docosane.

$C_{18}H_{29}O_4N$, Diisoamyl Amine Acid Phthalate - Acetone - Glycerol (II 318).

$C_{18}H_{32}O_2$, Linoleic Acid. See methanol - isooctane.

$C_{18}H_{34}O_2$, Oleic Acid. See methanol - isooctane or olive oil; acetonitrile-isooctane; ethanol - olive oil; propane - triolein, cottonseed oil, or abietic acid; methoxyethanol - isooctane.

$C_{18}H_{36}O_2$, Stearic Acid. See propane - methane or palmitic acid.

$C_{19}H_{34}O_2$, Methyl Linoleate. See methanol - isooctane.

$C_{19}H_{36}O_2$, Methyl Oleate. See methanol - isooctane.

$C_{19}H_{38}O_2$, β-Methoxyethyl Palmitate. See methoxyethanol - isooctane.

$C_{20}H_{30}O_2$, Abietic Acid. See propane - oleic acid.

$C_{21}H_{40}O_2$, β-Methoxyethyl Oleate. See methoxyethanol - isooctane.

$C_{22}H_{44}$ (approx.) Vaseline Oil. See methanol - CCl_4 (II 5), $CHCl_3$ (II 15); diethyl amine (II 280); naphthalene (II 650); camphor (II 679).

$C_{22}H_{46}$, n-Docosane. See furfural - diphenylhexane..

$C_{25}H_{50}$ (approx.), Paraffin or Ceresin. See ethanol - benzene.

C_{25} (approx.), Lubricating Oil. See methanol or ethanol - benzene.

POLYMETHACRYLIC ACID. See benzene - cyclohexane.

$C_{51}H_{98}O_6$, Palm Oil. See methanol.- fatty acid.

$C_{57}H_{104}O_6$, Olive Oil. See methanol or ethanol - oleic acid.

COD LIVER OIL and HAKE LIVER OIL. See methanol or ethanol - fatty acids or nonsaponifiables.

RAPESEED OIL. See methanol - benzene.

CASTOR OIL. See 96% ethanol - gasoline.

CITRAL and LEMON OIL. See ethanol.

POLYSTYRENE. See methanol - benzene.

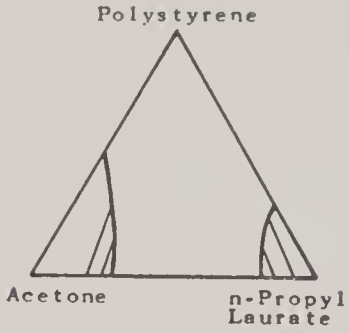
POLYSTYRENE with two solvents.

(J. N. Bronsted and K. Volgvartz, Trans. Faraday Soc., 36, 619, 1940).

Polystyrene absorbs mixed solvents and swells but does not dissolve in the liquid phase. Twelve triangular diagrams are given which for this

POLYSTYRENE with two solvents (cont.)

reason are not the usual types for liquids. The solvents are n-butanol with methyl, ethyl, and n-propyl laurates and isoamyl benzoate; n-propyl laurate with acetone, n-butyl ether, and ethyl laurate; acetone with m-cresol and ethylene glycol monoacetate; ethanol with benzyl ether; acetonitrile with benzyl benzoate; and n-butyl ether with n-butyl sebacate. Each system has only a single binodal area except the one shown.



QUATERNARY AQUEOUS SYSTEMS

Several quaternary systems have been presented already since they were intended to have only three "components" with the fourth, water, added merely to modify solubility. This is substantially the only effect in a double nonconsolute system such as results in the pentenes-phenol-pentane system. But with a binodal curve of the simple parabolic shape the effect of water is usually to give a sharp reverse curve as with sulfuric acid-ether-tetrachloroethylene; methanol-benzene-gasoline; ethanol-benzene-lubricating oil. The tendency is apparent in the ethanol-oleic acid-olive oil system, and may have been overlooked in the acetic acid-toluene-heptane system. For all such systems tie lines do not terminate on the phase boundary curve as shown on a plane diagram, and the plait point may disappear. This is recognized by Prutton, Walsh, and Desai (1950) (Figs. 7, 9) in their "equilibrium mixture". Methods of delineating tie lines for quaternary systems on plane diagrams were devised by Brancker, Hunter, and Nash (1940, 1941) and by J.C.Smith (1944).

POTASSIUM IODIDE - Mercuric Iodide - Ether.

(A. C. Dunningham, J. Chem. Soc., 105, 724, 2623, 1914). Compositions in gms. per 100 gms. liquid at 20°.

Lower Layer				Upper Layer				Solid Phase
Water	KI	HgI_2	Ether	Water	KI	HgI_2	Ether	
73.6	3.5	10.5	12.4	2.0	0.2	1.6	96.2	HgI_2
61.8	4.4	15.5	18.3	1.9	0.3	1.9	95.8	"
17.6	5.2	26.5	50.7	3.8	1.4	8.7	86.1	"
12.8	4.3	22.9	60.0	6.5	2.5	14.0	77.0	"
9.6	3.1	17.9	69.4	Plait Point				
40.7	55.6	-	3.7	0.4	0.4	-	99.2	KI
9.8	38.5	51.1	0.6	1.1	1.2	3.0	94.7	$KI+KHgI_3$
12.7	36.2	50.2	0.9	3.4	3.6	9.3	83.7	$KHgI_3$
13.2	33.7	51.7	1.4	7.6	14.1	33.8	44.5	"
15.9	31.7	49.5	2.9	13.8	19.7	42.8	23.7	"
17.2	26.6	47.2	9.0	Plait Point				

Bottom Layer				Middle Layer				Top Layer			
Water	KI	HgI_2	Ether	Water	KI	HgI_2	Ether	Water	KI	HgI_2	Ether
29.1	16.7	30.8	23.4	Same as bottom				3.4	2.1	6.2	88.3
33.7	20.5	32.9	12.9	19.5	13.1	28.7	38.7	4.2	2.7	7.7	85.4
31.5	21.9	34.2	12.4	15.4	10.3	26.6	47.7	5.6	4.1	12.8	77.5
31.6	22.4	35.9	10.1	11.3	8.8	21.9	58.0	8.7	5.8	16.6	68.9
32.4	22.4	35.2	10.0	9.1	7.1	19.2	64.3	Same as middle			

SODIUM CHLORIDE - Sodium Oleate - Ethyl Acetate.

(E. L. Smith, 1932). Compositions in gms. per 100 gms. at 25°.

Lower Layer				Upper Layer			
Water	NaCl	Acetate	Soap	Water	NaCl	Acetate	Soap
56.7	27.7	7.1	8.5	2.5	-	96.0	1.5
55.5	9.1	12.6	22.8	2.6	-	95.5	1.9

Several other concentrations are given which are in equilibrium with ethyl acetate or with neat soap.

SODIUM CHLORIDE - Ethanol - Amyl Alcohol.

(Fontein, 1910). Compositions in gms. per 100 gms. at 28°.

Water	NaCl	Ethanol	Amyl	Water	NaCl	Ethanol	Amyl
73.43	26.35	0	0.22	4.5	0.05	0	95.45
72.55	25.30	1.9	0.25	3.8	0.10	9.5	86.6

CHLOROFORM - Acetic Acid - Acetone.

Data are given above under aqueous systems Chloroform - Acetic Acid.

(Brancker, Hunter, and Nash, 1940a). Calculated compositions for 25 additional tie lines in this system are given by J. C. Smith (1944).

ACETALDEHYDE - Acetone . Vinyl Acetate.

(Pratt and Glover, 1946). Original not available to compiler.

ETHANOL - Oleic Acid - Olive Oil.

(Ruis and Martinez-Moreno, 1947). See the anhydrous system.

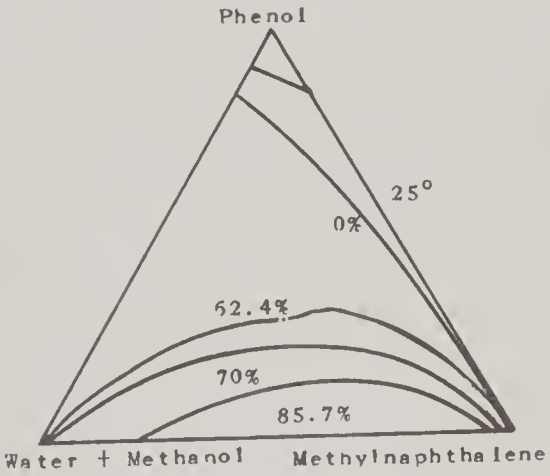
METHANOL - Phenols - Hydrocarbons.

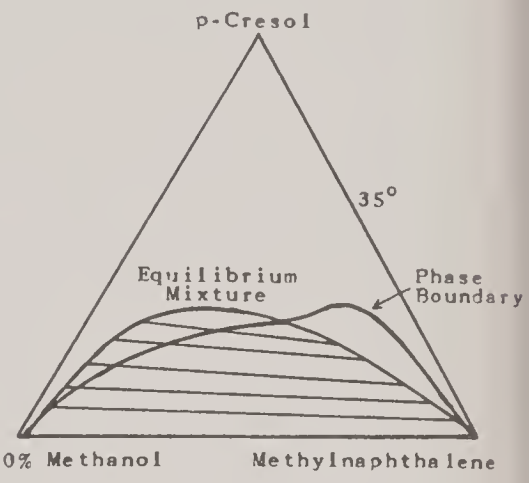
(Prutton, Walsh, and Desai, 1950). Eight quaternary systems and two systems of five components were studied in part. Usually the "solvent" was 70% methanol, 30% water but other concentrations were tried in some cases. The results are recorded in graphs and extensive tables in gms. per 100 gms. liquid, mostly at 35°.

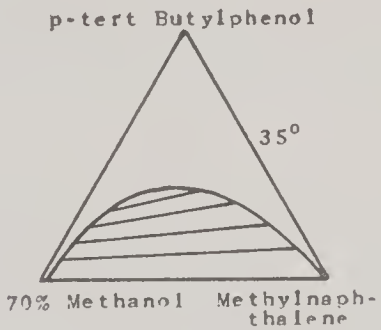
The first graph shows "phase zone boundaries" which are the usual binodal curves as in most other graphs in this book. The curve for 62.4% methanol shows a perceptible hump which, however, is much less pronounced than the one for 96% methanol - benzene - gasoline because phenol is far more tolerant of water than is benzene. The reason for the lack of a hump on the other curves of the phenol graph is not clear.

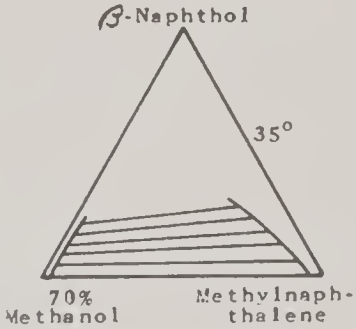
The second graph shows two curves, both for 70% methanol. One is the usual binodal curve or phase boundary which is definite and shows a slight hump. The other is called "equilibrium mixture" and shows the compositions of the two liquid phases when they are nearly equal in volume. It is lower on the right because the methylnaphthalene extracts methanol from the solvent making its concentration 79.6 to 90% methanol in that phase. The curve is higher on the left because the methanol concentration in the solvent phase is reduced to 61.6 to 69.2% (calculated from "Quaternary Tie Line Data" p. 1216). This curve is indefinite since it would vary considerably in position with the relative volumes of the phases. The two curves would coincide for a ternary system. In Fig. 9 of the original two other curves "20%" and "60%" are shown. These are not "% methanol in solvent" as stated but % methanol in the system. The "0%" curve is copied above under water - p-cresol - methylnaphthalene.

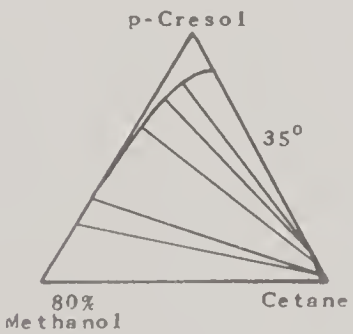
The other six graphs all show "equilibrium mixtures" rather than phase boundary curves. A point slightly above the right portions of one of these curves would not represent a homogeneous composition, as might be inferred, since it would be well below the hump of the phase boundary curve. If they were phase diagrams, the graphs should include lines showing compositions of liquid in equilibrium with solid phases such as drawn near the top of the first two graphs, but much lower in the cases of p-tert butylphenol (m.p. 99°) and β-naphthol (m.p. 122°), so that they would probably intersect the binodal curves. The position of the isopycnic (dashed line), added by the compiler to the last graph, is approximate.

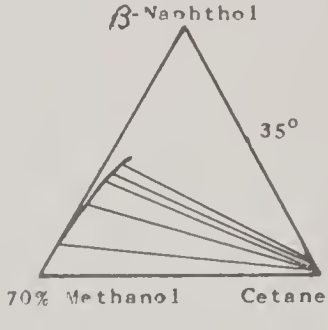




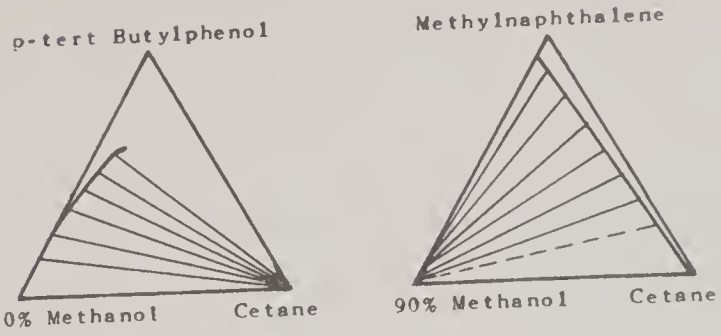








QUATERNARY AQUEOUS SYSTEMS



In the five component systems the components were reduced to three nominal ones in which one was 70% methanol, another was 60% methylnaphthalene and 40% of isooctane (2,2,4-trimethylpentane), and the third was phenol or p-cresol. Phenol was used also with the second component 43.4% methylnaphthalene and 56.6% isooctane.

NONAQUEOUS SYSTEMS.

Carbon disulfide - Methanol . Oleic Acid . Olive Oil (J.M.Martinez-Moreno and M.A.C. Gonzales, Anales fis y quim. (Madrid) B44, 391, 1948; Chem Abstracts, 42, 8602). Original not available to compiler.

METHANOL - Ethylene Glycol - Toluene - Skellysolve B.

(A. S. Smith and Funk, 1944). A solvent, 70% methanol and 30% glycol was tested for extraction of toluene from a hydrocarbon mixture at 15.5° and 29.4°. Results were almost independent of temperature. The following show enrichment of toluene in the solvent free extract compared with the solvent free raffinate:

Wt. % toluene in extract	15	42	59	78	90
" " " " raffinate	4	20	40	70	87

C_4H_6, Butadiene - Isobutene - Furfural - Naphtha.

(A. S. Smith and Braun, 1945). Portions of the data on this system at -6.7° have been recalculated to gms. per 100 gms. saturated liquid as follows:

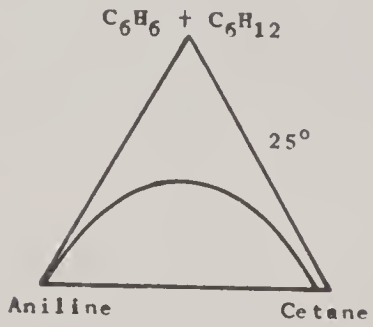
Lower Layer				Upper Layer			
Furfural	Naphtha	C_4H_6	C_4H_8	Furfural	Naphtha	C_4H_6	C_4H_8
81.5	3.55	4.85	10.1	9.2	23.3	17.1	50.4
78.7	6.1	7.8	7.4	5.8	42.9	22.0	29.3
77.7	4.1	5.6	12.6	5.5	41.3	14.0	39.2
79.5	3.7	5.7	11.1	9.6	28.7	15.4	46.8
76.0	3.0	5.75	15.25	12.94	7.06	20.2	59.8
69.3	7.1	18.6	5.0	17.4	25.9	43.0	13.7
65.3	0.0	26.5	8.2	30.2	13.6	41.2	15.0
64.2	3.15	17.35	15.3	23.5	5.1	33.3	38.1
57.1	12.1	15.0	15.8	6.3	51.3	19.7	22.7
75.2	7.25	9.1	8.45[a]	7.85	41.9	22.9	27.35[a]

(a) 1-Butene instead of isobutene.

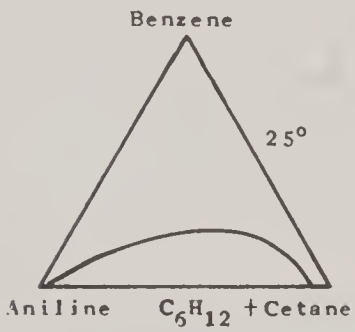
QUATERNARY NONAQUEOUS SYSTEMS

C_6H_6, Benzene - Aniline - Cyclohexane - Cetane.

(T. F. Brown, 1948). Compositions in gms. per 100 gms. saturated liquid at 25°.



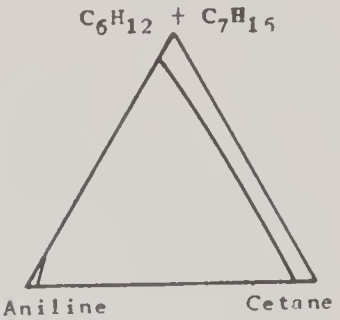
Aniline	C_6H_6	C_6H_{12}	Cetane
97.7	0.0	0.0	2.3
73.11	11.59	11.59	3.72
61.83	15.71	15.71	6.75
50.21	18.65	18.65	12.50
35.25	20.83	20.83	23.10
23.34	21.10	21.10	34.46
16.32	18.95	18.95	45.78
11.21	14.53	14.53	59.74
8.47	9.93	9.93	71.68
6.30	0.0	0.0	93.70



The refractive index of each of these compositions was recorded and used by interpolation to estimate the compositions of the liquid phases in equilibrium (tie lines). This method of analysis is valid for ternary systems but not for quaternary ones because the benzene and cyclohexane contents would not remain equal to each other in the two layers. Benzene would be concentrated in the aniline layer and cyclohexane in the cetane layer. The results would be more nearly correct if cyclohexane and cetane were grouped together as one "component" (second graph) and if it were assumed that the cyclohexane-cetane ratio remained uniform in the two layers. This is due to the fact that cyclohexane and cetane are closer in miscibility relations with aniline (aniline points 30.2° and 95°) than are cyclohexane and benzene (no aniline point but estimated by extrapolation at about −200°.

ANILINE - Cyclohexane - n-Heptane - Cetane.

(T. F. Brown, 1948). Compositions in gms. per 100 gms. saturated liquid.



Aniline	C_6H_{12}	C_7H_{14}	Cetane
93.50	2.94	2.94	0.63
89.70	5.15	5.15	0.0
10.60	44.70	44.70	0.0
8.76	32.91	32.91	25.42
7.65	25.40	25.40	41.56
6.58	11.26	11.26	70.90

Cf. note under previous system.

In this case the error in analysis is much less because of the much higher aniline point of n-heptane (70°), but there would still be some change in the ratio of the two light hydrocarbons in the two layers.

TABULAR INDEX OF AQUEOUS SYSTEMS

In compiling the data recorded in the preceding pages, a tabular index was prepared listing all of the more than 500 organic and 135 inorganic compounds which have been studied as components of ternary systems separating into two liquid layers. This index covers a large area and would be awkward to reproduce on book pages. It is hardly needed in this section because of the precise arrangement of data according to empirical formula, and because of the cross indexing. However, in the following condensed tabular index of aqueous systems 30 of the most frequently studied water immiscible components are listed in alphabetical order in the left column and 16 of the most common water miscible components are placed as column headings. n-Caproic acid, though not miscible with water, is given a column because most of its associated components are in the other group.

Page numbers without parentheses locate graphs, usually with numerical data also, and include 168 systems; nearly one third of the total so illustrated. Page numbers in parentheses refer usually to distribution data or material inadequate for a graph.

Besides furnishing a rapid index to these systems, another purpose of the table is to call attention by its blanks to the systems which have not been reported. Some of these would have theoretical or practical interest. It seems incredible that results for one system; water - ethanol - benzene, have been published 29 times, while others in the table have been neglected. Even heavy tonnage organic liquids such as acetic anhydride and β-chloroethanol have been given very little attention in this respect.

TABULAR INDEX AQUEOUS SYSTEMS

Water Immiscible Liquid ↓	Water Miscible Liquid: Acetic Acid	Acetone	n-Butyric Acid	n-Caproic Acid	Chloro-acetic Acid
n-Amyl Alcohol	(900-1)	950	(987)	(1039)	882
Aniline	890(901)	953	988	-	-
Benzene	890(901)	952	(987)	(1022)1039	882
Bromobenzene	(901)	951	-	1039	-
n-Butanol	(888,900-1,994)	949(994)	(987,994)	(994,1039)	-
sec-Butanol	(888,901,997)	-	(987,994)	(997,1039)	-
2-Butanone (M.E.K.)	(887,901)	-	(982,987)	(1039)	-
Carbon Disulfide	845(901)	845	847	-	845
Carbon Tetrachloride	839(901)	840	842	843-4,1039	838-9
Chloroform	849-50(900-1)	850-1	852-3	(853,1039)	849
Cyclohexane	(901)	(953)	-	-	-
Ether	889(900-1,1004)	950	(987,1004)	(1039)	(1004)
Ethyl Acetate	888(900-1)	949	-	-	-
Ethyl Bromide	-	-	-	-	882(902)
Furfural	(900)	950	-	-	-
Gasoline	899(901)	(955)	-	-	-
n-Heptane	-	955	-	-	-
n-Hexane	(901)	954	-	-	-
Isoamyl Alcohol	-	-	(987)	-	882(1018)
Isobutanol	(888,900,997)	950(997)	(987,997)	-	882(997)
Isopropyl Ether	891-2,896(901)	-	(987)	-	882(1018)
Methyl Iodide	-	-	-	1039	859
Nitrobenzene	889(901)	-	(987)	1038	882
o-Nitrotoluene	896(901)	-	(987)	-	882
Olive Oil	(901,1062)	(957,1062)	(987,1062)	(1039,1062)	(882,1062)
Petroleum Ether	(901)	-	(987)	(1039)	-
Phenol	(890,901)	952-3	-	-	-
Toluene	(897,901,1044)	954	(987,1044)	1039(1044)	(882,1044)
o-Toluidine	897	-	989	-	-
Xylene	899(901,1050)	955-6	(987)	(1039)	(883)

TABULAR INDEX AQUEOUS SYSTEMS

Water Immiscible Liquid ↓	Water Miscible Liquid: Dichloro-Acetic Acid	Ethanol	Formic Acid	Isobutyric Acid	Iso-propanol	Lactic Acid
n-Amyl Alcohol	-	916	(856)	(990)	-	(900)
Aniline	-	922	857	-	(970)	962
Benzene	(880)	920-2	857	(990)	970	-
Bromobenzene	-	917	-	-	-	-
n-Butanol	-	912(994)	(856,994)	-	995	(900,994)
sec-Butanol	-	-	(856,997)	-	-	-
2-Butanone (M.E.K.)	-	(910)	(856)	-	-	-
Carbon Disulfide	-	845	(844)	-	846	-
Carbon Tetrachloride	838-9	840	838	842	842	-
Chloroform	(849)880	850	(848)	(853)	852	(852,900,962)
Cyclohexane	-	923	-	-	971	-
Ether	(1004)	913(1005)	856(1004)	(990,1005)	-	(900,962)
Ethyl Acetate	-	(908)911	-	-	985	(900)
Ethyl Bromide	880(902)	902	-	-	-	-
Furfural	-	-	-	-	-	(900)
Gasoline	-	932(1048)	-	-	(974,1048)	-
n-Heptane	-	931-2,1048	-	-	1048	-
n-Hexane	-	925	-	-	971-2	-
Isoamyl Alcohol	-	917	-	(990,1018)	-	(900,962)
Isobutanol	-	912-3(997)	-	-	-	(900,997)
Isopropyl Ether	-	-	(857)	-	972-3	(901,962)
Methyl Iodide	-	(858)	-	-	-	-
Nitrobenzene	880	918	856	(990)	-	-
o-Nitro-Toluene	880	927	858	-	-	-
Olive Oil	(1062)	(940,1062)	(858)	(990,1062)	(974,1062)	-
Petroleum Ether	-	916	(856)	(990)	-	-
Phenol	-	922	857	-	-	(901)
Toluene	880(1044)	927-8(1045)	(858,1044)	(990,1044)	973,1045	-
o-Toluidine	-	929	-	-	(974)	(962)
Xylene	(880)	933-4	858(1050)	(990)	974	-

TABULAR INDEX AQUEOUS SYSTEMS

Water Immiscible Liquid ↓	Water Miscible Liquid: Methanol	n-Propanol	Propionic Acid	Pyridine	Trichloro Acetic Acid
n-Amyl Alcohol	(862)	964-5	(959)	-	876
Aniline	866	966	(959)960	1012	-
Benzene	865	966	(959)960	1011-2	(877)
Bromobenzene	863	965	-	-	-
n-Butanol	861(994)	995	(959,994)	-	-
sec-Butanol	-	-	(959,997)	-	-
2-Butanone (M.E.K.)	-	-	(959,982)	-	-
Carbon Disulfide	844	846	846	847	(844)
Carbon Tetrachloride	838	841	841	843	838-9
Chloroform	848-9	852	851	853	(849)876
Cyclohexane	867	967	-	-	-
Ether	862(1005)	(1005)	(959)	-	(877,1005)
Ethyl Acetate	861	984	-	-	-
Ethyl Bromide	860	902	(902,959)	-	(876,902)
Furfural	-	-	-	-	-
Gasoline	(870,1048)	(968,1048)	-	-	-
n-Heptane	867,870,1048	(968,1048)	-	-	-
n-Hexane	867	-	-	-	-
Isoamyl Alcohol	863	965	(959,1018)	-	(876,1018)
Isobutanol	861(997)	-	(959,997)	-	-
Isopropyl Ether	-	-	(960)	-	-
Methyl Iodide	(858)	(858)	-	-	859
Nitrobenzene	863	-	(959)	-	876
o-Nitrotoluene	868	-	(959)	-	876
Olive Oil	(871,1062)	(986,1062)	(959,1062)	-	(1062)
Petroleum Ether	(862)	-	(959)	-	-
Phenol	866	-	-	1012	877
Toluene	868,1045	968,1045	(959)961	1012	876(1044)
o-Toluidine	869	-	(959)961	-	-
Xylene	871	968	(959)962	1013	-

RECENT CONTRIBUTIONS TO THE THEORY OF ELECTROLYTE SOLUBILITY

Roger G. Bates

National Bureau of Standards, Washington, D. C.

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This review is an attempt to summarize the many worthwhile contributions to the theory of solubility that have been made in the quarter century that has passed since the appearance of J. H. Hildebrand's monograph, "Solubility" (55). Later editions of this important work (56) deal exclusively with the solubility of non-electrolytes, and it is therefore appropriate that this chapter should concern itself with recent progress toward an understanding of the many factors influencing the solubility of salts and other electrolytes in different solvent media. The literature survey has covered those contributions listed by Chemical Abstracts from January 1924 to July 1949, inclusive. The list of references, however, is not exhaustive.

I INTRODUCTION

In a few decades the study of the solubility of non-electrolytes has grown from a modest beginning to the full stature of a useful theory. The theory of electrolyte solubility, on the contrary, proved a child of different nature, beset by varied ills on the path from an equally promising infancy toward adulthood. In spite of the freely offered guidance of his brother, he has been unable to cast off entirely the awkwardness of the early years.

The elucidation of the factors affecting the solubility of solid non-electrolytes has advanced to such a point that quantitative predictions are often possible. Although considerable progress has also been made toward an understanding of the factors that determine the saturation concentration of an aqueous salt solution, the mode of interrelation of these factors is so complex that predictions must usually be limited to orders of solubility where wide differences are involved.

When salt is dissolved in water, the fugacity and activity of the water decrease, as evidenced by a lowering of the vapor pressure. Accompanying the decrease in activity of the solvent there is an increase in the activity of dissolved salt. As salt is added the activity ity increases from zero and reaches, at the saturation concentration, the activity of the pure salt, for equilibrium between the solid and solution phases has then been established. As a first approximation, the partial pressure, p, of solute from the solution has then become equal to the sublimation pressure, p_s, of the pure solid. Here, as elsewhere in this chapter, "saturation with salt" refers to saturation with the anhydrous salt.

When solid salt, solution, and vapor are in equilibrium, the system is univariant, and the temperature cannot be changed without altering the concentration of dissolved solute. The difference between the rate of decrease of the fugacity of the solid salt and that of the dissolved salt by reduction of the temperature depends upon the difference in heat content of the salt in these forms.

It was noted in the last century that the solubility curve, obtained by plotting the concentration of the saturated solution as a function of temperature, resembles a freezing-point curve for solutions of different concentrations. The solubility curve is indeed a freezing-point curve for a system in which solid salt is made to freeze from water by reducing the temperature. In the same way, the ice curve may be regarded as representing the solubility of ice in the liquid salt. The analogy between the heat of solution (at the saturation concentration) and the heat of fusion is evident. At the eutectic point the

fusion and solubility curves intersect, and further removal of heat converts the liquid phase into solid salt and ice. Two solids, a liquid of fixed composition, and vapor co-exist at the eutectic temperature.

Most salts are not appreciably volatile at ordinary temperatures. If the solubility of salt increases indefinitely, the solubility curve must connect the eutectic temperature with the triple point of the solute. Hence, the vapor pressure (3-phase pressure) of such solutions must pass through a maximum, and a saturated solution of the salt may possess two boiling points (14, 121, 123).

The ideal solubility, in mole fraction, is given by p_s/p^o, where p_s is the sublimation pressure of the solid and p^o is the vapor pressure of the pure liquid solute, extrapolated to the temperature in question. Although electrolytic solutions can hardly be considered ideal, the ideal solubility is of more than historical interest. It is related to the heat of fusion, L_f, by the familiar equation, first derived by Schröder from his study of the relation between solubility and melting point (126)

$$\frac{d \ln x_2}{d T} = \frac{L_f}{RT^2} \qquad (1)$$

where x_2 is the mole fraction of solute. Inasmuch as the melting point of most salts is so much higher than that of ice, it is scarcely possible to obtain the latent heat of fusion of the salt at temperatures at which solubility measurements are usually made. Hence, L_f is often replaced by its counterpart ΔH_s, the "fictitious" heat of solution or differential heat of solution at saturation, the heat absorbed when one mole of salt is dissolved in a large amount of nearly saturated solution.

$$\frac{d \ln x_2}{d T} = \frac{\Delta H_s}{RT^2} \qquad (1a)$$

If ΔH_s is considered to be independent of temperature, equation 1a can be integrated:

$$\log x_2 = \frac{-\Delta H_s}{2.303R} \left(\frac{1}{T} - \frac{1}{T_f} \right) \qquad (2)$$

where T is the temperature, on the Kelvin scale, of the saturated solution in which the mole fraction of solute is x_2 and T_f is the melting point of the solute on the same scale.

When Raoult's law is not obeyed, the ideal solubility is considerably different from the actual solubility. However, it is possible to derive equations similar in form to equation 2 for non-ideal systems, as will be shown later. The parallelism between $\Delta H_s/RT$ and observed ln c for four salts, where c is the saturation concentration, is demonstrated in table 1, taken from Butler (24). Certain qualitative conclusions of rather general application can be drawn from an examination of equation 2. Since L_f and ΔH_s are normally positive and T is always less than the melting point, T_f, the solubility should increase with increase of temperature. Likewise, the solubility is expected to be greater the lower the melting point and heat of solution.

Table 1

Solubility and heat of solution

	ln c	$\Delta H_S/RT$
NaCl	1.81	0.28
KCl	1.40	2.32
TlCl	-4.13	8.79
AgCl	-11.46	13.01

The solubility of most salts in water at ordinary temperatures calculated by equation 2 is far less than the actual value, because of extensive hydration and dissociation in solution (67). It is generally agreed (55, 102, 123 126) that this equation is unsuitable for the calculation of salt solubilities, inasmuch as water and salt are too polar to form solutions that are even approximately ideal, and the heat of solution cannot justifiably be assumed to remain unchanged over large intervals of temperature. Nevertheless, the system ammonium nitrate and water has been found to follow the ideal curve rather closely (29). Similar agreement between observed and calculated limiting heats of solution has also been obtained from studies of the solubility of sodium nitrates and of the following ternary systems: water, ammonium and sodium nitrates; and water, ammonium and sodium chlorides (97).

Ionization of an electrolyte in solution tends to increase the solubility, even as it operates to lower the freezing point and the vapor pressure. Other factors that influence the solubility of non-electrolytes (55), namely solvation, internal pressure, and polarity, must also be considered. Solvation, which increases solubility, is promoted by differences in acidic or basic character of the solvent and solute and by other possibilities for association. "Like dissolves like", and equal polarity of solvent and solute usually means increased solubility. Comparisons of solutions in non-aqueous solvents demonstrate that the dielectric constant has a primary effect upon the electrolytic dissociation of a salt and the dissolving power of a solvent for electrolytes, but the solvation energy is often of even greater importance (59, 60).

Solubility, like other physicochemical properties of solids, is to some degree a function of particle size. The modified Ostwald equation relating solubility and particle size is (53, 130)

$$\ln \frac{c}{c_o} = \frac{2M\sigma'}{driRT} \qquad (3)$$

where c_o is the normal solubility in moles per liter, c the greater solubility of small particles of radius r, M is the molecular weight, and d the density of the crystal. The factor i reflects the increase in number of particles in solution due to electrolytic dissociation, with proper corrections for ionic activity, and σ' has the dimensions of specific free surface energy (erg cm^{-2}).

II. SOLUBILITY FORCES

The forces that determine solubility are those which influence all of the colligative properties of the solution. The fundamental problem, therefore, is to determine how the escaping tendency of the molecules varies with composition and with the specific natures of the components (55).

From the kinetic point of view, equilibrium between two phases occurs when equal numbers of molecules of every species concerned pass the phase boundary in both directions in the same time. Hence, the solubility of a solid is determined by two opposing factors, first the surface attractive forces of the solid that tend to build up the lattice forms of the solid state, and second, attractive forces, exerted by the liquid on the molecules of the solid, which tend to break down these forms (16, 24). The latter are also the forces that determine the fugacity or escaping tendency of the dissolved solute. Hence, empirical correlations between solubility and other properties of electrolytic solutions may sometimes be found. For example, the following relationship between water solubility, S, and electrolytic decomposition potential, P, has been found to hold for the alkali and alkaline-earth halides (13):

$$S = 0.1\ (5.7-P)^3 \qquad (4)$$

By the application of statistical mechanics to the conditions at the boundary surface, Butler (24) expressed solubility by the equation

$$\ln c = \frac{W_1-W_2}{RT} - \ln \frac{N_0}{1000\nu N}\sqrt{\frac{W_2}{2M}} \qquad (5)$$

where W_2-W_1 is the total work done by a molecule in passing from the surface of a solid into the interior of a liquid, equal to ΔH_s, the heat absorbed upon solution of a mole of solid in the saturated solution. In this equation, N_0 represents the Avogadro number, N the number of molecules in each square cm of the surface of the solid, and ν is the vibration frequency. On differentiation of 5 with respect to temperature, the analogue of equation 1a is obtained. In a later paper, Butler (25) confirmed the Fajans rule (41, 42, 43)

$$\Delta H_s = \sum (\text{heats of hydration of the gaseous ions}) - (\text{salt lattice energy}) \qquad (6)$$

He pointed out, as well, that a rough parallelism exists between ΔH_s and the solubility of salts, although the relation is modified by surface conditions. The calculation from the interionic attraction theory of the heat developed on dissolving a salt in water or in a solution of another salt has been discussed by Debye (33).

Bjerrum (27) has attempted a calculation of the solubility of typical salts in the following manner. First, the work of separating the ions of the solid was computed from lattice theory. Inasmuch as this represents a heat of evaporation, the pressure of ionic vapor over the salt could be obtained with the aid of the Nernst heat theorem. The calculation of the lattice energy has also been considered by Born and Mayer (18). As Fredenhagen has pointed out (46), all substances have a certain vapor pressure, and accordingly solubilities can be related to the gas phase by considering the partition of solute between solution and vapor. If the relation between solution concentration and ionic vapor pressure were known, the concentration of a saturated solution (above which the vapor pressure of ions equals that above the solid salt, i.e., the sublimation pressure) could be computed. Bjerrum estimated these so-called ionic partition coefficients by regarding the ions as rigid spheres of known radii, with the charge at the center, immersed

in a dielectric continuum. The electrical work on dissolving the ion was then calculated by the Born method (17). The partition coefficients of molecules resembling the ions in question but without the charge (argon for potassium, methane for ammonium, etc.) were used, together with the electrical work of solution, to compute approximate coefficients for the ions of the simplest salts.

By this procedure Bierrum derived the equation

$$\log c = \frac{\epsilon^2 \log e}{2kT}\left[\left(\frac{1}{2r_1}+\frac{1}{2r_2}\right)\left(1-\frac{1}{D}\right)-\frac{1.57}{a}\right]+\log V_1+\log V_2+8.0 \qquad (7)$$

where ϵ is the ionic charge and k the Boltzmann constant, r_1 and r_2 are the ionic radii, D the dielectric constant of the solvent, a the distance between ions in the crystal, and V_1 and V_2 the partition coefficients of the gases resembling the ions in structure. Unfortunately, this formula was found to give poor results in the calculation of solubility, but the correctness of Bierrum's approach is apparent. Small changes in the ionic radii produce large changes in the calculated solubility. Furthermore, Born's formula does not yield sufficiently accurate values for the ionic work of solution. The "dielectric discontinuity" of solvents in the neighborhood of dissolved ions may likewise require consideration.

As some of the solubility variables are functions of the sizes of the ions and the ionic charges, a relation between solubility and ion size may be sought (28, 48). High stability of the crystal means low solubility. It is found that maximum stability occurs when the ions are not of equal sizes but when the anion is from one and one-third to twice as large as the cation. This effect apparently is the result of polarization of the negative ion by the field of the positive ion. Hence, the smaller positive ion has the greater stabilizing effect. If there is too great disparity in the ionic sizes, however, the small ions do not keep the large ones apart, and the resulting repulsions enhance the solubility of the crystal. Thus cesium fluoride is a thousandfold more soluble in water than is lithium fluoride.

Kortüm (69) and van Arkel and de Boer (136) have discussed the calculation of the lattice energy and the energy of hydration of the ions. The solubility of salts is largely determined by a relatively small difference between these two large energy quantities. Hence, small changes, if they affect these in different ways, can cause a large change in the difference. A quantitative theory of solubility is therefore exceedingly difficult to formulate. Nevertheless, as Garrick (48) points out, large, even millionfold, differences of solubility are found among simple salts, and for a qualitative, comparative explanation of these differences only electrostatic terms need be considered.

If hydrolysis is negligible, the order of increasing solubility is that of increasing S,

$$S = \Sigma W - U \qquad (8)$$

where W is the electrostatic hydration energy and U is the electrostatic lattice energy. Equation 8 is consistent with the rule of Fajans, equation 6, and with the approximate parallelism between solubility and ΔH_S.

In Garrick's treatment, the lattice energy is represented by

$$U = Bz^2/(r_+ + r_-) \qquad (9)$$

where B is a constant depending on the structure of the crystal and z is the valence of one ion. The energy of hydration, W, of each ion is a function of both z and a quantity r' known as the "corrected radius". The relationship is expressed by an equation of the Born form. The corrected radius is used in place of the actual radius in an attempt to correct for the high values of W furnished by the Born charging formula for actual ions in a dipolar liquid such as water. Modified ionic radii were employed earlier by Latimer, Pitzer, and Slansky (85) in their calculation of the free energy of hydration. Accordingly W is qualitatively described by

$$W = Az^2/r' \qquad (10)$$

where A is a constant. Although the Born equation predicts that the hydration energy will be independent of the sign of the ionic charge, this is found not to be true. Equality of hydration energies is not realized for pairs of ions in which the cation and the anion are of equal radii but rather when the anion is somewhat the larger. Thus r' for anions is greater by 0.25 A than the actual radius and that for cations less than the actual radius by the same amount. This correction was derived from a spherical model for the water molecule, where the dipole is located at a distance from the geometrical center.

Garrick's theory leads to the following predictions: (a) increasing the ionic valences in the same ratio, for example from 1:1 to 2:2, leads to a decrease of solubility; (b) the solubility decreases when the sum of the ionic radii decreases; and (c) if the ratio of radii changes while the sum remains constant, electrolytes of the symmetrical valence type will display a minimum of solubility when the corrected radii (r') are equal, whereas electrolytes of the 1:2 valence type will have a minimum solubility when the corrected radius of the bivalent ion is greater than that of the univalent ion by a factor of about 1.2.

Table 2 summarizes the ionic radii, corrected radii, and solubilities for the alkali halides in the anhydrous condition. The solubility is seen to be low on the diagonal line and high at the corners, in accordance with the radius-ratio effect. If cesium bromide and iodide are excluded, there is a trend toward lower solubility along the diagonal toward decreasing radii, as predicted by the radius-sum effect. The low solubility of lithium fluoride is the combined result of two factors. The corrected radii are nearly equal, and their sum is also low. The high solubility of potassium fluoride emphasizes the importance of the corrected radii in predicting the solubility, for the actual radii of the ions of this salt are nearly equal.

The foregoing treatment is necessarily restricted to the simplest salts, since only electrostatic terms have been taken into account. If the cation is not of the rare-gas type, the solubility relations may be too complicated to be completely explained. Abnormally low solubilities (for example those found for the halides, oxides, and sulfides of the heavy metals) are generally attributed to large van der Waals terms in the lattice energy, and the order of decreasing solubility in these

Table 2

Ionic radii and solubility of anhydrous salts

(from Garrick)

	Anion →	F^-	Cl^-	Br^-	I^-
	r →	1.33	1.81	1.96	2.20
	r' →	1.08	1.56	1.71	1.95
Cation	r ↓	r' ↓			
Li^+	0.78	1.03	0.07	24	*24	*26
Na^+	0.98	1.23	1.0	5.6	11	18
K^+	1.33	1.58	21	4.5	5.3	9
Rb^+	1.49	1.74	*29	7.1	6.0	6.8
Cs^+	1.65	1.90	*38	11	5.1	2.7

*lowest hydrate, solubility of anhydrous salt presumed to be greater

cases is that of increasing polarizability of the anion, namely Cl, Br, I, S. However, some salts, notably fluorides, nitrates, and perchlorates, are more soluble than the corresponding compounds of the alkali or alkaline-earth series. The polarizability of fluoride is less than that of water. Hence, it is possible that van der Waals terms in solution, greater than those in the lattice, must sometimes be taken into account.

III. SOLUBILITY EQUILIBRIA AND THERMODYNAMICS

Various attempts have been made to modify equation 2 in such a way that it expresses with improved accuracy the solubility relations of non-ideal systems. Hildebrand (55, 56) introduced the specific heats of liquid and solid solute to correct for the alteration of the heat of fusion (and hence ΔH_S) with temperature changes. Noyes, van't Hoff, Rothmund and others (124) have multiplied the right side of equation 2 by 1/i, where i is the van't Hoff ratio. Mortimer (98, 99) substituted fL_f for ΔH_S on the right side of this equation, where L_f is the molal heat of fusion and f is a constant for each solvent-solute system. The value of f is evidently the ratio of the experimental slope of the plot of log x_2 versus 1/T to the ideal slope calculated from the latent heat of fusion of the solute. It is a measure of the relative internal pressures of the two components.

More recently Austin (11) has shown that equation 2 can be written in the approximate though useful form

$$\log x_2 = \frac{\Delta H_S}{RT} \log \frac{T}{T_f} \qquad (11)$$

since $(T/T_f)-1$ is nearly equal to ln (T/T_f). In cases where equation 11 is valid, a straight line will result when the solubility in mole fraction is plotted on log-log paper as a function of absolute temperature. Thus equation 11 may sometimes be used advantageously as an interpolation formula. If ΔH_S is a linear function of temperature, the same straight-line plot of the reduced temperature, T/T_f, versus solubility in mole fraction is obtained for all substances with the same entropy of fusion.

An attempt has been made recently (63) to relate the solubility of salts to the entropies of ions in the crystal. The following expression for the activity, a, of salt at saturation was derived:

$$nRT \ln a = \Delta H_s + T \sum S_i \qquad (12)$$

in which n is the number of ions in the molecule of salt, S_i is the entropy of an ion, estimated by

$$S_i = 1.5\ R \ln A + 1.5\ z^2/r \qquad (13)$$

where A is the atomic weight, z the charge of the ion and r its radius. Entropies of salts calculated by summation of S_i for the constituent ions are said to agree well with experimental data.

A. Solubility and temperature

These modifications of the ideal solubility equation are necessarily of limited application in the study of electrolyte solubility. A better representation of the thermodynamic relation between the heat of solution and the saturation concentration in such non-ideal systems can be developed from a knowledge of the properties of strong electrolytes and the activity coefficient (26, 88, 139). The following derivation is based on the treatment given by Williamson (139).

The equilibrium constant, K, for the process

$$\text{solvent} + \text{solute electrolyte (s)} = \text{saturated solution (m)} \qquad (14)$$

is given by $K = (\gamma m_{\pm})^{\nu}$, where m is the molality of electrolyte in the saturated solution, $m_{\pm}$ is the mean ionic molality, γ is the mean stoichiometric molal activity coefficient, and ν is the number of ions released by each molecule of salt upon solution in the solvent. The standard heat content change for process 14 is identical with the negative of $L_2(s)$, the difference between the heat content of the pure solute and its heat content at infinite dilution in the solvent. Likewise, $d\ln m_{\pm} = d\ln m$, for $m_{\pm} = \text{constant} \times m$. Hence, the van't Hoff equation takes the form

$$\left(\frac{d\ln\gamma}{dT}\right)_{satd.} + \left(\frac{d\ln m}{dT}\right)_{satd.} = \frac{-L_2(s)}{\nu RT^2} \qquad (15)$$

Since

$$d\ln\gamma = \left(\frac{\delta \ln\gamma}{\delta m}\right)_T dm \qquad \left(\frac{\delta \ln\gamma}{\delta T}\right)_m dT \qquad (16)$$

we obtain, by differentiation

$$\left(\frac{d \ln \gamma}{dT}\right)_{satd.} = \left(\frac{\delta \ln \gamma}{\delta m}\right)_T \left(\frac{dm}{dT}\right)_{satd.} + \left(\frac{\delta \ln \gamma}{\delta T}\right)_m \qquad (17)$$

Hence

$$\left(\frac{\partial \ln \gamma}{\partial T}\right)_m + \left(\frac{dm}{dT}\right)_{satd.} \left[\left(\frac{\delta \ln \gamma}{\delta m}\right)_T + \left(\frac{1}{m}\right)\right] = \frac{-L_2(s)}{\nu RT^2} \qquad (18)$$

But

$$\left(\frac{\partial \ln \gamma}{\partial T}\right)_m = \frac{-\bar{L}_2}{\nu RT^2} \qquad (19)$$

where $\bar{L}_2$ is the relative partial molal heat content of solute in the saturated solution (86). Furthermore, $\bar{L}_2 - L_2(s)$ is the heat of solution ΔH_S, in the saturated solution. Thus we obtain, by substitution in 18

$$\Delta H_S = \nu RT^2 \left(\frac{dm}{dT}\right)_{satd.} \left[\left(\frac{\delta \ln \gamma}{\delta m}\right)_T \left(\frac{1}{m}\right)\right] \qquad (20)$$

The satisfactory agreement between ΔH_S calculated from solubilities and that obtained from calorimetric data is evident in table 3, taken from Williamson (139). The calculation of ΔH_S for sodium carbonate decahydrate was made with a modified form of equation 20 applicable to hydrated salts.

Table 3

Comparison of ΔH_S from solubility and calorimetry

	t	Solubility	Calorimetry
		cal. mole $^{-1}$	cal. mole^{-1}
KCl	25	3,380	3,300
$Ba(NO_3)_2$	25	6,805	6,974
$Na_2CO_3 \cdot 10H_2O$	20	13,500	13,960
NaOH	25	2,750	2,585

Equation 20 can be applied to non-electrolytes by setting $\nu = 1$. If, further, the activity-coefficient term vanishes (as it does approximately for many uncharged solutes), this equation reduces to the ideal relation. For slightly soluble salts, the activity-coefficient term decreases in importance in comparison with 1/m. Under such conditions the change of activity coefficient with molality can be expressed satisfactorily by the Debye-Hückel equation (34). Hence, for small intervals of temperature in which ΔH_S and γ change but slightly, the fol-

lowing integrated form of equation 20 is useful (88):

$$\Delta H_S = \left(\frac{1+\gamma}{2}\right) \frac{\nu R T_2 T_1}{T_2 - T_1} \ln \frac{m_2}{m_1} \qquad (21)$$

where m_2 and m_1 are the solubilities at temperatures T_2 and T_1, respectively. It should be emphasized that equation 21 is applicable only at low ionic strengths.

With the aid of the van der Waals equation, Perreu (104) has derived the following expression for the solubility, c, in moles of salt per mole of total water, of salt hydrates $S \cdot sH_2O$:

$$\frac{s\alpha c}{1-sc} \cdot \frac{\Delta H_S}{T} - \left(\frac{\partial \log p}{\partial c}\right)_T \cdot \frac{dc}{dT} = 0 \qquad (22)$$

where p is the vapor pressure and ΔH_S the heat of solution of the hydrate in the saturated solution. Values of ΔH_S calculated from solubility data were compared with the observed. For sodium sulfate pentahydrate the difference was less than 1.25 percent and for manganese chloride tetrahydrate, 0.8 percent.

Perreu's equation can be applied with success to a calculation of the change of slope of the solubility curve (from $\tan \beta$ to $\tan \alpha$) at the transition point, where the composition of solid salt changes from $S \cdot s_2H_2O$ to $S \cdot s_1H_2O$. If s_1 is less than s_2,

$$\frac{\tan \alpha}{\tan \beta} = \frac{(1-s_1c)\,\Delta H_{S2}}{(1-s_2c)\,\Delta H_{S1}} \qquad (23)$$

B. Solubility and pressure

The effect of pressure is readily predicted by the Le Chatelier principle and is expressed, for ideal systems, by

$$\left(\frac{\partial \ln x_2}{\partial P}\right)_T = -\frac{\Delta V}{RT} \qquad (24)$$

where ΔV is the partial molal volume of solute in the saturated solution less the molal volume of the solid solute (55, 88, 44). If solution results in a decrease of volume (negative ΔV), the solubility is increased by increase of pressure. A rigorous derivation of the effect of pressure upon solubility in non-ideal electrolytic solutions appears not to have been made.

IV. MEDIUM EFFECT ON THE SOLUBILITY OF ELECTROLYTES

The properties of electrolytic solutions in different media are known to depend primarily upon the dielectric constant of the solvent. In the last century, Nernst (101) and Thomson (135) advanced the empir-

ical rule that the product of the dielectric constant and $(1-\alpha)$, where α is the degree of electrolytic dissociation, is a constant. Kraus and Fuoss have been remarkably successful in explaining conductance phenomena in non-aqueous media by electrostatic (coulomb) forces which bring about the formation of ion pairs, triple ions, and even higher aggregates as the dielectric constant is lowered (see reference 78 and subsequent contributions by the same authors). Similarly, the effect of a non-electrolyte upon the solubility of a salt in water can be attributed primarily to changes in dielectric constant (27, 91) and extent of solvation (45) or association (22, 137). An adequate expression of the relationship, however, requires a knowledge of the electrostatic work obtained on dissolving the gaseous ions in the solvent. The Born equation is not sufficiently accurate for the purpose, and a complete quantitative theory is consequently as yet unavailable.

Brönsted (22) considers the differential free energy in a saturated solution to be composed of three terms, namely changes of thermal, electrical, and chemical energy. At saturation the algebraic sum of these must be zero. Furthermore, chemical forces of the van der Waals or London type will often be of less importance than the electrical forces and can be ignored as a first approximation. If, then, only the thermal and charge effects, E, are considered, and the latter are expressed by the Born equation (17), we have for the molar solubility s

$$-kT\, d \ln s = dE = \frac{\epsilon^2}{2\bar{r}}\, d(1/D) \qquad (25)$$

where $\bar{r}$ is the mean ionic radius and D the dielectric constant of the solvent. According to equation 25 the solubility should increase continuously with increasing dielectric constant. On the contrary, it has been predicted (129) that the solubility (in mole fraction) will pass through a maximum at some medium dielectric constant and that dx_2/dD is negative for solvents of very low dielectric constant and positive for those whose dielectric constant is high. Data can be found in the literature to support this theory (129). Nevertheless, the general application of these rules has not yet been demonstrated.

Although electrical forces play the most important part in determining the potential of dissolved substances, Brönsted recognizes that attractions between solvent molecules and association of the solute ions into ion pairs and higher aggregates modify to a great degree the actual relation between solubility and dielectric constant. Furthermore, the electric fields of the dissolved ions and dipolar molecules themselves probably influence the effective dielectric constant in their immediate vicinity. The plot of log m as a function of 1/D is an irregular line, but only slight changes in D would be necessary to make this line a continuous curve (22).

Ricci, Davis, and co-workers (32, 116, 117) have compared experimental solubilities in media of different dielectric constant with those calculated by an integrated form of equation 25

$$\frac{1}{z_+ z_-} \log \frac{s_2}{s_1} = \frac{N\epsilon^2}{2.303RT(2\bar{r})} \left(\frac{1}{D_2} - \frac{1}{D_1}\right) = -\frac{C}{2\bar{r}} \left(\frac{1}{D_2} - \frac{1}{D_1}\right) \qquad (26)$$

where N is the Avogadro number, $\bar{r}$ the mean ionic radius, and C is 242 at 25°. Reasonable values for the ionic radii of silver acetate have been obtained from solubility measurements in alcohol-water mixtures containing up to 30 percent alcohol (89). The Born formula is an ideal equation taking no account of ionic interactions. If corrections for interionic effects in the two solvents are made by the Debye-Hückel equation (34), equation 26 becomes

$$\frac{1}{z_+ z_-}\log\frac{s_2}{s_1} = -\frac{C}{2\bar{r}}\left(\frac{1}{D_2}-\frac{1}{D_1}\right)+\frac{B\sqrt{\mu_1}}{D_1^{3/2}(1+Aa\sqrt{\mu_1}/\sqrt{D_1})} - \frac{B\sqrt{\mu_2}}{D_2^{3/2}(1+Aa\sqrt{\mu_2}/\sqrt{D_2})} \qquad (27)$$

where A and B are constants, μ is the ionic strength, and a is the ion-size parameter.

Equations 26 and 27, like 25, predict lower solubilities than are found experimentally. An empirical relation that expresses much more closely the actual change of solubility with dielectric constant has been suggested by Ricci and Davis. This formulation is based upon the observation (32) that the last two terms of equation 27 are practically identical. This constancy of the activity coefficient of a salt at saturation has been confirmed for silver acetate in mixtures of water and alcohol, acetone, and dioxane (58, 116) and for potassium, barium, and zinc iodates in dioxane-water mixtures (116, 118).

If the ion-size parameters of equation 27 are set equal to zero, which is equivalent to assuming the validity of the Debye-Hückel limiting law, the following approximate relationship is derived from the rule of constant activity coefficient

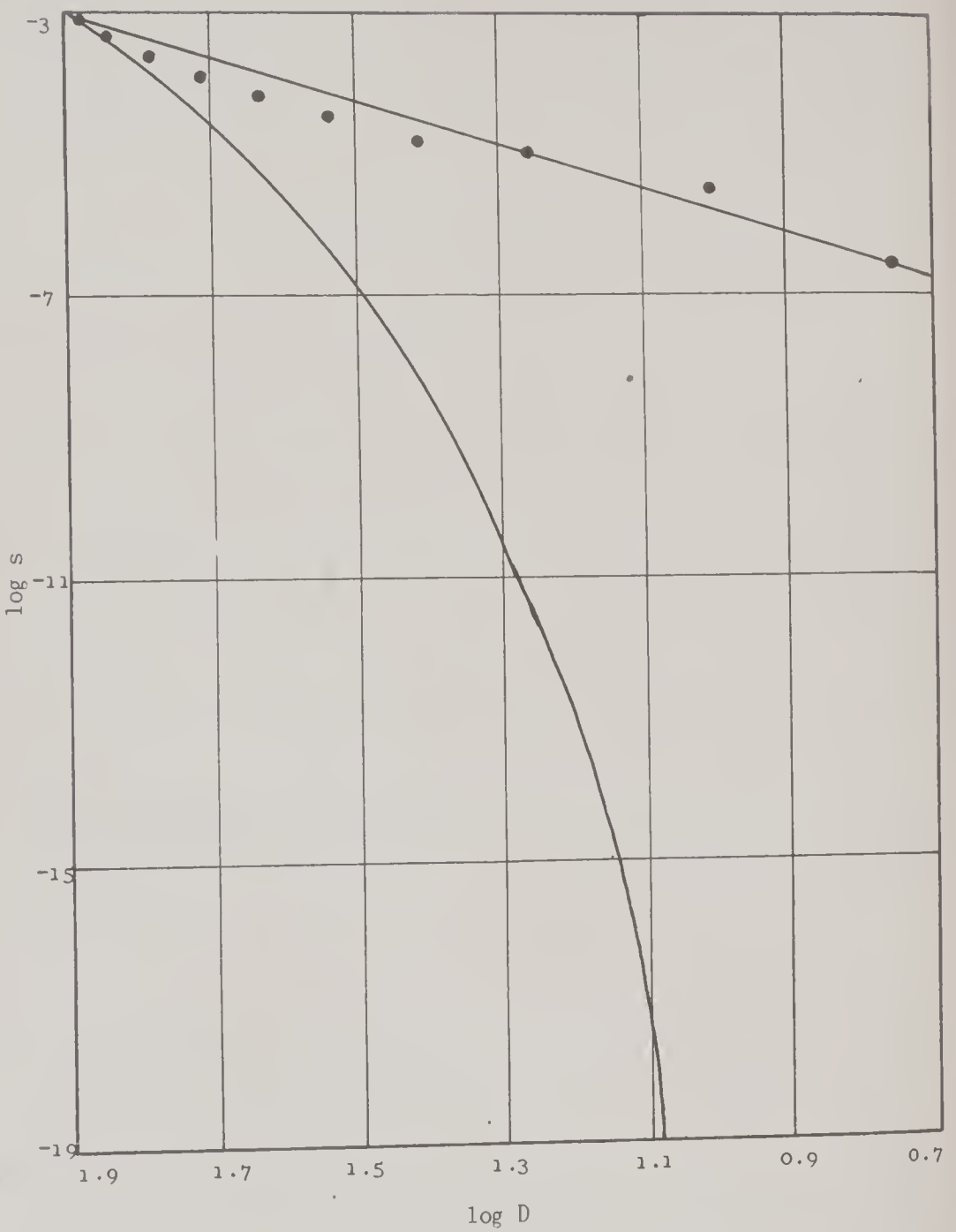
$$\sqrt{s_1}\,/D_1^{3/2} = \sqrt{s_2}\,/D_2^{3/2} \qquad (28)$$

or

$$\log s_2 = \log s_1 + 3(\log D_2 - \log D_1) \qquad (28a)$$

A plot of the logarithm of the solubility against the logarithm of the dielectric constant should therefore be a straight line with slope of 3. That this is at least approximately the case for dioxane-water mixtures is shown in figure 1, taken from the paper of Ricci and Davis (116), where log s for barium iodate monohydrate is plotted as a function of log D. The solid lines are the predicted solubilities in the mixtures based upon the known solubility in water. The upper curve was calculated by equation 28a, the lower by 26, and the dots represent the observed solubilities.

A probable cause of the failure of the Born treatment as applied to mixed solvents is to be sought in segregation or sorting of the solvent molecules by the salt ions. If this effect is large, equation 26 should apply more closely near zero ionic strength than at finite concentra-



Fugure 1. Solubility of barium iodate monohydrate in dioxane-water mixtures plotted as a function of dielectric constant (from Ricci and Davis)

Figure 1.

tions. A better test of the Born equation should therefore be possible with solubilities extrapolated to zero ionic strength than with actual solubilities as has been customary. Ricci and Leo (117) have shown that the solubilities of silver acetate calculated by 26 for mixtures containing up to 30 percent dioxane are indeed in somewhat better agreement with limiting values obtained in this way than with the observed solubilities. Hence, an attempt was made (118) to modify equation 26 with the aid of the Debye treatment to take into account sorting of the solvent molecules by the ions, in order to correct for the large negative error in the calculation of solubilities in solvents of low dielectric constant. However, the modified equation was found to predict solubilities that were higher than the observed.

V. REPRESENTATION OF SOLUBILITY DATA

Phase diagrams offer valuable means of presenting solubility data in condensed and useful form. In recent volume (108), Purdon and Slater have described in a thorough manner the construction and use of phase diagrams, including discussions of triple coordinates, five-component systems, triangular diagrams, and projections of the Jänecke type.

Empirical and semi-empirical equations based upon the relationships discussed in earlier sections, for example equation 11, are often employed to express the change of solubility with temperature. These are most useful for relatively simple systems and permit ready interpolation of data at any temperature within the range of validity of the formula. If ΔH_s in equation 1a is expressed as a quadratic function of absolute temperature, T, and the equation is integrated, the following expression for the solubility, x_2, is obtained.

$$\log x_2 = \frac{A}{T} + B \log T + CT + D \qquad (29)$$

in which A, B, C, and D are empirical constants. Kracek (77) was able to express the solubility of potassium thiocyanate in water between room temperature and 177° C. by this equation, with appropriate change of constants above the polymorphic inversion point at 140.6°.

Dühring's relation, which enables vapor pressure data to be estimated when too few measurements are available to construct the curve of vapor pressure with respect to temperature, can be applied successfully to the interpolation of solubilities as well (54, 105). The method is based upon two observations, that (a) the solubility curves of salts in water are usually of similar shape, and (b) a straight line is usually obtained upon plotting the temperature at which one nonhydrated salt has a certain solubility with respect to the temperature at which a second (reference) salt is equally soluble. The solubility need be known at only two or three temperatures to fix the Dühring line. Thallous nitrate is the only exception to this rule so far found among nonhydrated inorganic salts (54). The Dühring line for this substance is curved.

Accurate solubilities for potassium nitrate over a wide range of temperatures are available, and this salt is accordingly a suitable choice as a reference substance. Although solubilities vary widely, the method can be applied quite generally by multiplying the lower solubility by a constant of the necessary magnitude to make the ranges overlap. The calculated solubility must then, of course, be divided by the constant. The results yielded by the Dühring rule are often as accurate as

the known data themselves, and the differences rarely exceed 5 percent even when the two salts are chemically dissimilar. The results shown in table 4, taken from the paper of Harris (54), illustrate the applicability of this method of interpolating solubilities. In each case the "observed" solubilities at the lowest and highest temperatures were used to construct the Dühring lines.

Table 4

Solubilities calculated from Dühring lines

(moles salt per 1,000 g. water)

t	Silver nitrate		Ammonium chloride		Cesium nitrate	
	calc.	obs.	calc.	obs.	calc.	obs.
-15	-	-	-	*4.60	-	-
- 5	-	*5.60	-	-	-	-
0	6.66	6.65	5.53	5.55	-	-
5	7.93	7.80	-	-	-	-
10	9.19	9.20	6.20	6.22	-	-
15	10.61	10.75	6.56	6.58	-	-
20	12.15	12.30	6.92	6.97	-	-
25	13.82	14.00	7.32	7.38	-	-
30	15.62	15.95	7.75	7.78	-	*1.86
40	19.50	19.50	8.54	8.63	2.52	2.61
50	-	*23.6	9.43	9.43	3.34	3.50
60	-	-	10.29	10.34	4.37	4.52
70	-	-	11.19	11.20	5.53	5.64
80	-	-	12.17	12.15	6.98	6.92
90	-	-	13.20	13.2	8.57	8.40
100	-	-	-	*14.2	10.29	10.10
110	-	-	-	-	-	*12.2

* Data used to fix Dühring lines

VI. MIXTURES OF ELECTROLYTES

The solubility of slightly soluble salts in solutions of a second substance has long been a useful tool in studies of the thermodynamics of electrolytic solutions and of the interactions among ions and neutral molecules. The first experimental verification of the Debye-Hückel limiting law for activity coefficients (34) was made with solubility data (23, 80). Likewise, measurements of the solubility of one salt in the presence of another have aided materially in formulating the rules that govern specific ionic interactions (20, 21, 51).

A. Solubility, activity coefficients, and ionic equilibria

The chemical potential and activity of salt in a saturated solution are equal to those of the solid solute with which the solution is in equilibrium. For an electrolyte each molecule of which dissociates into ν ions (ν_+ positive ions and ν_- negative ions)

$$K_{sp} = a_+^{\nu_+} a_-^{\nu_-} = a_\pm^{\nu} = (m_\pm \gamma_\pm)^{\nu} \qquad (30)$$

where K_{sp}, $a_{\pm}$, $m_{\pm}$, and $\gamma_{\pm}$ are the activity solubility product, mean ionic activity, mean molality (i.e., the solubility), and the mean stoichiometric activity coefficient, respectively. Whenever equilibrium with solid salt has been established and the temperature and pressure remain unchanged, the product ($m_{\pm} \gamma_{\pm}$) for the saturating salt must be a constant no matter what changes are produced in solubility by varying the concentration and type of a second electrolyte. Inasmuch as the activity coefficient becomes unity at zero ionic strength, the value of the constant product ($a_{\pm}$ or $K_{sp}^{1/\nu}$) can sometimes be obtained by extrapolation of solubility data for solutions of varying ionic strengths (86, 113). The Debye-Hückel equation is often used to facilitate the extrapolation. Thus

$$a_{\pm} = K_{sp}^{1/\nu} = m_{\pm}(0) \qquad (31)$$

where $m_{\pm}(0)$, the solubility at zero ionic strength, cannot be realized experimentally. Activity coefficients of the saturating salt in each mixture are readily calculated when the constant activity or solubility product constant is known.

An abnormally large solubility signifies a low stoichiometric activity coefficient (compare equation 30). It may also mean an unusually small real activity coefficient, but more often it points to the existence of solute in forms other than simple ions. Davies and co-workers (15, 30, 31, 90) have explained the abnormal solubilities of thallous chloride and iodate and barium chlorate and iodate in salt solutions by allowing for incomplete dissociation. Increased solubility has also been shown to result from interactions of the ions of cadmium, copper, lead, mercury, silver, thallium, and zinc with anions (68, 81, 112, 115), with neutral molecules (35, 64, 138), and with the dipolar ions of amino acids (65, 66) to form complex ions. Solubility measurements have also been used successfully in the study of metallic oxides (47, 62) and of the association of silicate ion in alkaline solutions (120). In all of these investigations it was possible to compute constants for the various equilibria concerned.

The influence of hydrogen-ion concentration upon the solubility of slightly soluble salts of weak acids has received considerable attention (12, 40, 87, 100, 131, 132). The increased solubility in these instances results not from reaction with the metallic ion but from interaction of hydrogen ion with the anion to form undissociated acid. The dissociation constants of weak acids can be obtained from measurements of this kind.

Naidich and Ricci (100) have calculated the thermodynamic dissociation constant of iodic acid from the solubility of barium iodate monohydrate in solutions of hydrochloric acid, nitric acid, and in solutions of the corresponding potassium salts. Their treatment well illustrates the application of modern solution theory to solubility equilibria in mixtures of electrolytes. The increased solubility in the acid solution over that in the corresponding salt solution of the same ionic strength (in which the dissolved barium iodate was assumed to have the same activity coefficient) was related to the actual concentrations of iodate and hydrogen ions and of un-ionized iodic acid in the acid solutions. The thermodynamic constant was then derived from the concentration constants by application of appropriate corrections for activity coefficients.

The method described by Larsson (83) is applicable when the acid itself is slightly soluble. From the solubility of benzoic acid in solutions of a benzoate salt and in solutions of sodium and potassium chlorides, Larsson calculated the dissociation constant of benzoic acid and the activity coefficient of the acid in the salt solutions (84). The determination of second dissociation constants by this method is sometimes possible (82).

B. Solubility of highly soluble salts in solutions of other electrolytes

It should be noted that the application of equations 30 and 31 is not limited to slightly soluble electrolytes. However, a practical limitation is imposed by the difficulty of obtaining $m_{\pm}^{(0)}$ from measurements which are necessarily restricted to relatively high ionic strengths.

In an important series of papers, Akerlof and co-workers (1, 2, 6, 9, 10) have extended the theory of electrolyte mixtures to enable the calculation of the solubility of highly soluble electrolytes in solutions of other electrolytes to be made. Inasmuch as $a_{\pm}$ for the saturating salt cannot be obtained by extrapolation to zero ionic strength, it is necessary first to obtain this quantity by other means.

The first basic assumption of this method permits the activity coefficient in the saturated solution to be calculated from experimental data at lower concentrations

$$\log \frac{\gamma_0}{\gamma_R} = k_1 \mu_T \qquad (32)$$

The activity of salt in the saturated aqueous solution is then computed directly. In equation 32, γ_0 is the activity coefficient of the salt at ionic strength μ_T, γ_R is the activity coefficient of a reference electrolyte at the same ionic strength, and k_1 is a constant. This expression is consistent with the Hückel (61) and Guggenheim (49, 50) equations for activity coefficients, provided the two electrolytes are of the same valence type and their ion-size parameters are regarded as equal in the Hückel treatment. Equation 32 is also used by Akerlof as an extrapolation function to compute the activity coefficient of the saturating salt at ionic strengths higher than can be attained experimentally in the absence of a second electrolyte at the given temperature, namely at concentrations corresponding to its solubility in solutions of a co-solute. Hydrochloric acid is a logical choice as a reference electrolyte, for its activity coefficient is known at concentrations extending to 16 molal (7), or well above the solubility of most familiar salts. If equation 32 is valid, γ_0 need be known at only two concentrations to fix the value of k_1.

In order to calculate the solubility of a salt in a solution of a co-solute by equation 31, it is not only necessary to know the activity of the solid phase but also the activity coefficient of the saturating salt in the co-solute medium. Equation 32 furnishes γ_0, the value of the desired quantity in a pure aqueous solution of the saturating salt of the proper ionic strength, μ_T, but does not allow for the specific effect upon the activity coefficient resulting from replacement of a fraction of the salt by co-solute. The second basic assumption of Akerlof's method is the empirical linear variation, with composition, of the activity coefficient of an electrolyte in a mixture of constant total

ionic strength (compare reference 50)

$$\log \gamma = \log \gamma_o + k_2(\mu_T - \mu_X) = \log \gamma_o + k_2 \mu_C \quad (33)$$

where μ_X and μ_C are the ionic strengths of the saturating salt and of the co-solute, respectively. The solubility, μ_X, of a uni-univalent salt in a solution of a co-solute that has no ion in common with the saturating salt is obtained by combination of 32 and 33 with equation 30

$$\log \mu_X = \log a_\pm - \log \gamma_R - k_1 \mu_T - k_2 \mu_C \quad (34)$$

where γ_R is the activity coefficient of the reference electrolyte at the ionic strength μ_T.

Unfortunately, the ratio of the activity coefficients of two strong electrolytes of the same valence type (first assumption) is not always a linear function of the total ionic strength, as demanded by equation 32. For example, Akerlof has found considerable deviations from linearity for the ratio of the activity coefficients of sodium hydroxide (5) and potassium hydroxide (4) to those of hydrochloric acid (7) at high ionic strengths.

The second assumption has also been found not to be generally applicable (6), and equation 33 was amended as follows

$$\log \gamma = \log \gamma_o + k_2 \mu_C + k_3 \mu_C^2 \quad (33a)$$

For many mixtures, however, k_3 is zero. When the co-solute is a univalent electrolyte having an ion in common with the saturating salt, the solubility equation takes the form

$$\log \mu_X = 2 \log a_\pm - \log \mu_T - 2 \log \gamma_R - 2k_1 \mu_T - 2k_2 \mu_C - 2k_3 \mu_C^2 \quad (35)$$

Inasmuch as the values of μ_T and $\log \gamma_R$ depend upon μ_X, the calculation of solubility must be made by successive approximations.

Solubility equations similar to 35 can be written for homo-ionic co-solutes of the higher valence types (2). For uni-univalent salts as solid phases in solutions of homo-ionic co-solutes of the 2-1 valence type,

$$\log a_\pm = \log \gamma_R + k_1 \mu_T + k_2 \mu_C + k_3 \mu_C^2 + \tfrac{1}{2}\left[\log \frac{(2\mu_T + \mu_X)}{3} + \log \mu_X\right] \quad (36)$$

and for co-solutes of the 3-1 type,

$$\log a_{\pm} = \log \gamma_R + k_1 \mu_T + k_2 \mu_C + k_3 \mu_C^2 + \tfrac{1}{2} \left[\log (\mu_T + \mu_X)/2 + \log \mu_X\right] \quad (37)$$

This type of calculation has also been applied to solubilities in methanol-water mixtures (8) and to solutions saturated with more than one strong electrolyte (1). Akerlof and Turck (10) have employed equation 35 (with $k_3 = 0$) to make the reverse calculation, namely to compute the activity coefficient of hydrochloric acid from measurements of the solubilities of uni-univalent chlorides in solutions of the acid. The results agreed well with coefficients calculated from electromotive-force data.

Table 5, kindly made available by Dr. Akerlof, is an unpublished summary of the values of k_2 and k_3 for computing the solubility of sodium or potassium chlorides in solutions of 19 different chloride co-solutes at 25°. Log $a_{\pm}$ and k_1 (for hydrochloric acid as reference) are given at the bottom of the table. The value of γ_R for use in equations 35, 36, and 37 can be computed by the equation of Akerlof and Teare (7). The solubilities of sodium or potassium chlorides in solutions of hydrochloric acid have been computed by equation 35 and are compared in table 6 with the "observed" values found by Akerlof (3).

Thomas (134) has determined the solubility of mercuric chloride in various chloride solutions and has found these solubility equations inadequate to explain the observed results. For all practical purposes, mercuric chloride itself can be considered to be undissociated in aqueous solution. On the assumption that the added strong electrolyte is converted quantitatively into complex ions, Akerlof (3) has been able to account successfully for the observed solubilities of mercuric chloride in solutions of hydrochloric acid at 25°, as shown in table 7.

Other attempts have been made recently (106, 142) to apply empirical relationships to the representation of observed solubilities of electrolytes in mixtures with a common ion. Pozner (107) expresses the mean mole-fractional activity coefficient, f, of salt AB in a solution of AC by

$$f = f_0 (1 + a)^m \quad (38)$$

and the solubility, x, by

$$x = c_1 (1 + a)^n + c_2 \quad (39)$$

In these equations, x is the mole fraction of A; c_1, c_2, and n are constants; m is a function of n; and a is the ratio of concentrations (g. equiv. liter^{-1}) of C and B (106).

Table 5

Solubility constants with sodium and potassium chlorides as pure solid phases

Co-solute	Sodium chloride		Potassium chloride	
	k_2	k_3	k_2	k_3
HCl	0.0530	-0.0005	0.0512	-0.00167
LiCl	0.0400	-0.0005	0.0280	-
NaCl	-	-	0.0070	-
KCl	-0.0105	-0.0054	-	-
$MgCl_2$	0.0129	-	0.0097	0.0005
$CaCl_2$	-0.0048	0.00155	0.0053	0.0008
$SrCl_2$	-0.0075	0.00094	0.0015	0.0004
$BaCl_2$	0.0040(?)	-	-0.0056	-
$CuCl_2$	-0.0323	-	-0.0460	0.0013
$MnCl_2$	-0.00025	-	-0.0090	0.0002
$CoCl_2$	-0.0046	0.0006	0.0030	-
$NiCl_2$	0.0000	-	-0.0374	-0.00045
$ZnCl_2$	-0.1250	0.00545	-0.1330	0.0100
$CdCl_2$	-0.084	-	-0.051	-
$SnCl_2$	-	-	-0.034	-
$PbCl_2$	-0.130	-	-0.067	-
$AlCl_3$	-0.0034	0.0008	0.0089	0.0007
$FeCl_3$	-0.0333	0.0015	-0.0204	0.0017
$LaCl_3$	-0.0159	0.0012	0.0007	0.0008

	Sodium chloride	Potassium chloride
$\log a_{\pm}$	0.778	0.462
k_1	-0.0875	-0.118

Table 6

Comparison of calculated and observed solubilities of sodium and potassium chlorides in hydrochloric acid solutions at 25°

HCl	Sodium chloride		Potassium chloride	
	calc.	obs.	calc.	obs.
m	m	m	m	m
4.095	2.225	2.283	1.642	1.670
6.163	1.027	1.040	0.877	0.879
8.089	0.444	0.424	.516	.514
10.115	.184	.172	.339	.339
12.280	.0814	.0787	.269	.274
14.224	.0455	.0463	.267	.254

Table 7

Solubility of mercuric chloride in aqueous solutions of hydrochloric acid at 25°

HCl	Mercuric chloride	
	calc.	obs.
m	m	m
0.0986	0.3747	0.3747
.1335	.4117	.4144
.2227	.5064	.5076
.4599	.7586	.7549
.6998	1.0146	1.0019
.9344	1.2535	1.2508
1.1504	1.4978	1.4872
1.4039	1.771	1.763
1.7339	2.128	2.125
1.8861	2.294	2.292
2.102	2.530	2.535
3.166	3.706	3.750
4.428	5.140	5.232
5.889	6.867	6.929
6.189	7.235	7.246
6.577	7.855	7.704
9.319	10.204	10.64
0.14	11.103	11.07

C. Distribution between solid and liquid solutions

It is sometimes stated (see, for example, Rivett (119) that the limit of pure solid phase can never be reached in equilibrium with a mixture. From a kinetic point of view, this claim is easily justified. Many pairs of isomorphous salts are capable of forming solid solutions or "mixed crystals" whose compositions are variable over wide ranges (14). Roozeboom has classified these into five types on the basis of the mutual solubilities of the components A and B and the compositions with respect to the liquid phase from which the solid separates (122):

I. Continuous solid solution, and the concentration of A is greater in the liquid than in the solid at all compositions.

II. Continuous solid solution, and the concentration of A in the liquid exceeds that of A in the solid at low concentrations but is less at high concentrations.

III. Continuous solid solution, but the liquid contains less A than the solid at the low concentrations and more at the high.

IV. Incomplete miscibility with the formation of two solid phases (conjugate solid solutions). One contains less A than the liquid phase and the other more.

V. Incomplete miscibility with the formation of conjugate solid solutions, but the proportion of one salt in the liquid phase exceeds that of the same salt in both solid phases.

It is evident that there must be in types II and III a concentration where the proportions of A in liquid and solid are the same.

The existence of a sixth type of solid solution is suggested by the studies of Ricci (114) on the system sodium sulfate, sodium bromate, water at 37.5, 45, and 52°. Solid solutions of anhydrous sodium sulfate and sodium bromate are formed at these temperatures. Although miscibility is incomplete, no pair of conjugate solid solutions exists. There appears instead a single phase of solid solution in equilibrium with pure component.

The calculation of the compositions of the liquid and solid phases in equilibrium is often made by considering separately the relation between composition and partial molal free energy (chemical potential) of each component in each of the two phases. Equilibrium requires that the chemical potential of each component shall be the same in each phase. The chemical potential, however, approaches minus infinity as the mole fraction approaches zero and thus is not well suited to graphical representation. Seltz (127, 128) has suggested that fugacities or activities be employed instead and has derived equations for calculating the liquidus and solidus curves from the temperatures and heats of fusion of the two pure solids, on the assumption that both solutions are ideal. Scatchard (125) has pointed out a direct means of calculating the equilibrium compositions. He proposes that the activity or chemical potential of one component be plotted, for the two phases, with respect to that of the other component in the same phase. The curves intersect at equilibrium. The same standard state must be used for each state of aggregation. Additional plots of activity against composition will then yield the equilibrium compositions. A graph of the activity of one component of an ideal solution with respect to that of the other is a straight line, $a_1+a_2 = 1$. Negative and positive deviations from Raoult's law yield curves which lie on different sides of this line (125).

Hill, Durham, and Ricci have summarized the equilibrium relations between solid solutions of isomorphous salts and their saturated aqueous solutions (57). Their study included alums in which one of the cations was varied and also pairs of hexahydrated double sulfates, selenates, or chromates of a univalent and bivalent cation, one of which was varied. Two observations were made. First, the relation between y, the mole fraction of A in the liquid phase disregarding water, could be expressed by the empirical relation

$$y = x^m \qquad (40)$$

where m is a positive constant no greater than unity for these particular systems, and x is the mole fraction of A in the solid phase. In the second place it was found that the distribution depended in some way upon the ratio of aqueous solubilities of the two salts. In general, the salt with the higher molar solubility in water appeared to be present in higher proportion in the liquid than in the solid phase at equilibrium. The mean composition of mixed crystals which separate on cooling a binary mixture has also been considered by Korvezee and Scheffer (76).

From partly empirical and partly theoretical considerations Hill, Durham, and Ricci derived the relation

$$a_1 = kx_1^m \qquad (41)$$

for the activity of a component in the solid phase, where k is a proportionality constant introduced to allow for a choice of different standard states for the solid and dissolved component. The theoretical significance of m is unknown, but its value is doubtless determined by the relative attractions or repulsions between the components in the solid phase. For ideal systems of type I, m is unity. The system falls in type II when m is less than 1 and is classified in type III if m is greater than unity. From equation 41 it can be seen that a is greater than x in type II systems, and hence the systems show positive deviations

from Raoult's law. Type III includes those systems that show negative deviations from ideality.

VII. VAPOR PRESSURE AND SOLUBILITY

Although the solubility can be related theoretically to the partial pressure of solute vapor in equilibrium with the saturated solution, this approach is of little practical value in the study of electrolytes most of which are of low volatility. Nevertheless, changes in chemical potential or activity of the dissolved solute are manifest in the partial pressure of the solvent, and it is to be expected that solubility phenomena can often be interpreted profitably from this point of view.

A rather simple relationship between the mole fraction, x, of salt in a saturated aqueous solution and the vapor pressure, p, has been advanced by Kume (79)

$$\frac{p^o - p}{p} = k \frac{x}{1-x} \tag{42}$$

where p^o is the vapor pressure of pure water. The constant k is practically independent of temperature, changing, it was stated, only a few percent for potassium nitrate over a range of 300°. It has a definite value for each solute. These values range, for 46 salts, from 66.34 for cesium fluoride to 0.595 for mercuric chloride.

When the water solvent enters into combination with the electrolyte to form the solid phase, the water activity bears a rather direct relation to the saturation concentration. Pedersen (103) has considered the case of a salt S whose two hydrates S·m and S·n contain respectively m and n molecules of water to each molecule of salt. If p_m and p_n are the vapor pressures of the corresponding saturated solutions and $p_{m,n}$ is that of a mixture of the solid hydrates,

$$(n+1-k) \log (1-kx_n) + k \log x_n = (n-m) \log p_{m,n} + (m+1-k) \log p_m + k \log x_m - (n+1-k) \log P \tag{43}$$

where x is the mole fraction of salt in the saturated solution, P is defined by

$$P = p_m + \alpha x_m \tag{44}$$

and k by

$$k = \alpha / P \tag{45}$$

The symbol α in equations 44 and 45 represents the negative of the slope of the tangent to the experimental vapor-pressure curve at the point x_m, p_m. It is obtained from a plot of data for unsaturated solutions of the salt S as a function of x_m.

The application of equation 43 can be illustrated by a calculation of the solubility, x_n, of (metastable) anhydrous sodium bromide at 18° from the solubility, x_m, of the dihydrate. Thus m=2 and n=0. The mixture of anhydrous and hydrated salts has a vapor pressure, $p_{m,n}$, of 5.15 mm at this temperature. From measurements of the vapor pressure of unsaturated solutions of sodium bromide, α is found to be 58.2. Hence, P = 17.22 and k = 3.38. Data from Seidell yield x_m = 0.085 at 18°. The calculated value of x_n is 0.160. By extrapolation of solubilities of the anhydrous salt measured above 51°, x_n is found to be 0.165.

In the past decade, Dingemans, Korvezee, and Dijkgraaf have made important contributions to the theory of the so-called 3-phase pressure, namely the total pressure of the system solid salt, solution, vapor, over wide ranges of temperature. Inasmuch as solid salt is present at all times, the composition of the solution changes with changes of temperature. Applications of their theory comprise methods for finding the eutectic temperature of a binary system of two salts as well as for locating the temperature at which the pressure itself reaches a maximum.

Korvezee and Dingemans (71) have tested Kume's formula, equation 42, and found that k changes considerably for many salts over ranges of temperature much narrower than that specified by Kume (79). For example, k for potassium nitrate rises from 1.11 at 40° to 1.75 at 320°. Furthermore, k shows discontinuities at transition points. For an ideal system, Raoult's law gives

$$\frac{p^o - p}{p} = \frac{x}{1 - x} \qquad (46)$$

It is evident from a comparison of 46 with 42 that k would be unity if Raoult's law were obeyed. When a fraction α of the solute dissociates into n particles per molecule, the solution remaining ideal, k will be $1+\alpha(n-1)$. In other words, k will have a lower limit of 1 and an upper limit of n. The degree of dissociation, and hence k, will probably be temperature-dependent.

It has been found empirically that the relative vapor pressure, p/p^o, is usually nearly a linear function of T for 3-phase systems composed of solid salt, solution, vapor (37, 38, 70, 71). In some instances, however, the line is slightly curved, and a term in T^2 must be added. If the salt has a transition point, p/p^o is linear for each branch but undergoes a change of slope. The transition point cannot always be accurately located in this way. However, if it is known precisely by some other method, the heat of transition can be calculated from the difference of slope and the composition of the liquid (72).

When one of the components of a binary system of two salts exists in two crystalline forms, two eutectics, one stable and the other metastable, are found. The plot of relative vapor pressure of the aqueous solution saturated with the two salts is useful in locating both eutectic temperatures. The intersection of the high-temperature branch of the relative vapor-pressure line with the temperature axis ($p/p^o = 0$) gives the temperature of the stable eutectic. If the low-temperature branch is extended beyond the transition point, the metastable eutectic can be located in a similar manner (74).

The 3-phase line for systems consisting of solid salt in equilibrium with saturated solution and vapor extends from the eutectic temperature

to the melting point of the salt. Not far below the latter the pressure reaches a maximum. Roozeboom is credited with predicting theoretically the appearance of this maximum (121, 123).

The thermodynamic process resulting in the removal of one mole of water vapor from a saturated solution can be written

$$\frac{1}{1-x} \text{ mole salt, } H_2O \text{ (satd. soln.)} = 1 \text{ mole } H_2O \text{ (g)} + \frac{x}{1-x} \text{ mole salt (s); } \Delta H \tag{47}$$

and from the Clapeyron equation,

$$\frac{dp}{dT} = \frac{\Delta H}{T\Delta V} \tag{48}$$

where ΔV is the difference between the volumes of products and reactants in the above process. It is evident that ΔH, the change of heat content for the process, is the difference between two other quantities, namely the heat of vaporization of one mole of water from the saturated solution and ΔH_S, the differential heat of solution of $x/(1-x)$ mole of solid salt in the saturated solution. That is,

$$\Delta H = L_V - \frac{x}{1-x} \Delta H_S \tag{49}$$

Dingemans (36) explains the appearance of the maximum through the relative magnitudes of the two terms on the right of 49 at different temperatures. At low temperatures x is small, ΔH is positive, and the vapor pressure increases with increasing temperature (compare equation 48). At the maximum, $\Delta H = 0$, and at higher temperatures x is so large that ΔH becomes negative. The vapor pressure accordingly drops as the temperature of the system increases.

If the relative vapor pressure, p/p^o, is a linear function of T, the temperature of the maximum vapor pressure can be related rather simply to the slope, (sl), of the plot of p/p^o with respect to T (72)

$$(sl) = \frac{d(p/p^o)}{dT} = \frac{1}{p^o}\left[\frac{dp}{dT} - \frac{p}{p^o}\frac{dp^o}{dT}\right] \tag{50}$$

At the maximum the first term on the right is zero. Hence,

$$(sl) = -\frac{p}{p^o}\left(\frac{d\ln p^o}{dT}\right) \tag{51}$$

If the vapor pressure of water in the particular temperature range of interest is expressed by the empirical equation

$$\ln p^o = -\frac{a}{T} + b \tag{52}$$

and the constant a determined, we have

$$(s1) = -\frac{a}{T^2}\left(\frac{p}{p_o}\right) \tag{53}$$

from which the temperature of the maximum vapor pressure can be evaluated.

Although saturated solutions of electrolytes do not in any sense represent ideal mixtures, surprisingly good results for the temperature of maximum vapor pressure, T_m, can be obtained assuming ideal relationships (70, 73). The following treatment is that of Korvezee and Dingemans (73). For a mixture of components 1 and 2, whose vapor pressures in the pure state at the temperature T are p_1 and p_2 and whose mole fractions in the mixture are x_1 and x_2,

$$p = (1-x)p_1 + xp_2 \tag{54}$$

It is assumed that the liquid is saturated with respect to component 2. At the maximum, $dp/dT = 0$, and

$$(1-x)\frac{dp_1}{dT} + x\frac{dp_2}{dT} = (p_1-p_2)\frac{dx}{dT} \tag{55}$$

Combination of 55 with the Clausius-Clapeyron equation and with equation 1a, followed by substitution of the value of x so obtained in equation 2, gives an expression for the maximum temperature in terms of the vapor pressures and heats of vaporization and solution. If the restriction that p_2 is nearly zero is imposed, this becomes

$$\frac{1}{T_m} = \frac{1}{T_f} + \frac{R}{\Delta H_S} \ln (1 + \Delta H_S/L_V) \tag{56}$$

Furthermore, if ΔH_S is much smaller than the heat of vaporization, L_V, we have as a first approximation,

$$\frac{1}{T_m} = \frac{1}{T_f} + \frac{R}{L_V} \tag{57}$$

for under these conditions

$$\ln (1 + \Delta H_S/L_V) \approx \Delta H_S/L_V \tag{58}$$

If the value of L_V is taken to be the same as the latent heat of evaporation of 1 mole of pure water, or an average of 9,450 cal. $mole^{-1}$ between 50 and 200°, equation 57 can be written

$$\frac{1}{T_m} = \frac{1}{T_f} + 0.00021 \qquad (57a)$$

Table 8, taken from the paper of Korvezee and Dingemans (73), illustrates the essential agreement between the experimental temperatures of maximum vapor pressure and those computed by equation 57a for 11 solids. This satisfactory agreement suggests that omission of non-ideal terms in the derivation of equation 57 is of no particular significance. This conclusion has been affirmed by Korvezee (70) who amended the calculation to correct for departures from ideality. The derivation has also been extended by Korvezee, Dingemans, and Dijkgraaf (75) to permit a calculation of the temperatures of the two stable vapor-pressure maxima that are found for solutions saturated with two salts (39).

Table 8

Temperatures of maximum vapor pressure

Solid	Calculated	Observed
	C.	C.
KNO_3	267	265
KCl	582	565
α-$AgNO_3$	158	*161.5
β-$AgNO_3$	166	168.5
α-KCNS	133	135.3
β-KCNS	138	*138.8
δ-NH_4NO_3	115	117.1
ε-NH_4NO_3	132	132.0
$AgNO_3$-NH_4NO_3	82	85.5
Resorcinol	80	85.0
Pyrocatechol	77	82.0

*metastable

VIII. COLLOIDAL ELECTROLYTES

Gelatin and gum arabic have been found to increase the solubility of many acids and bases (19). The presence of soap has a similar effect. These and similar observations led McBain and McBain in 1936 to the conclusion that ". . . colloidal particles may be spontaneously and reversibly formed in solvents in which they are insoluble, provided that a suitable protective colloid is present to act as a solubilizing or stable protective agent." (94). Indeed, the phase rule has been shown to apply to soap systems and to all thermodynamically stable colloid systems (96). The phenomenon of solubilization, which consists in the spontaneous stable formation of self-organized colloidal particles, may occur in either aqueous or non-aqueous media (95). Solubilization is not to be confused with peptization, emulsification, or the protective action of surface-active substances upon pre-existing or mechanically formed particles.

The osmotic behavior and electrolytic conductance of soap solutions and solutions of high molecular weight aliphatic amines and their salts indicate that the solute is completely dissociated at low concentrations (92, 109, 111). These very dilute solutions, unlike those of higher

concentration, do not foam (111). As the amount of solute is increased, a critical concentration is reached where the curves of density and viscosity (140) and conductivity (92, 109, 141) manifest abrupt changes. Plots of specific conductance with respect to volume normality give two straight lines intersecting at the critical concentration (141). According to McBain, aggregation of simple solute molecules into micelles, the presence of which is confirmed by x-ray evidence, begins to take place at this concentration.

The first micelles formed are of low charge, the so-called "neutral colloid"; hence, the specific conductance decreases. At higher concentrations the conductance may pass through a minimum and increase as highly conducting ionic micelles are produced (92, 109). The solubility rises very sharply with temperature above the critical concentration for the formation of micelles (133). Furthermore, the magnitude of the solubility can be correlated with ability to form micelles (110).

Solubilization is believed to involve sorption of solute upon the micelles of the solubilizing agent and incorporation of solute within them. The phenomenon cannot be accounted for adequately by assuming a spherical micelle with the solute dissolving in the hydrocarbon portion. It seems likely that solubilized material is placed in layers within micelles of lamellar form (93).

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IX. GLOSSARY OF TERMS

activity. Ratio between the fugacity of a substance in the given state and its fugacity in an arbitrary standard state.
activity coefficient. The ratio of activity to concentration.
chemical potential. Partial molal free energy.
conjugate. Paired.
decomposition potential. In electrolysis, the voltage at which sustained decomposition of electrolyte takes place.
dipole. Separation of the centers of positive and negative electric charge within a molecule.
dipole moment. Product of the charge by the distance of separation of positive and negative centers.
entropy. Measure of the energy of a substance which is due to internal motion of the molecules and is unavailable for external work. It measures how far an energy system has degraded or "run down."
escaping tendency. Measure of the tendency of a substance to change from one state to another.
eutectic. Mixture of solute and solid solvent which separates when the system solidifies completely; a mixture of two or more substances having a lower constant melting point than any other mixture of the same constituents.
eutectic temperature. The temperature at which the eutectic mixture separates.
fugacity. Measure of escaping tendency; may be regarded as an ideal vapor pressure.
isomorphism. Crystallization of different compounds in the same form.

internal pressure. Resultant of the attractive and repulsive pressures within a liquid; cohesion pressure; energy density.

lattice energy. The forces that hold the atoms together in the crystal.

liquidus. When two components form both solid and liquid solutions, the temperature-concentration diagram consists of two curves. That for the liquid phase is termed the liquidus, for the solid phase the solidus.

medium effect. Influence of a change in character of the solvent medium.

micelle. A colloidal particle.

mole fraction. If n_i is the number of moles of component i and N is the total number of moles of all components, x_i, the mole fraction of i, is n_i/N.

phases. Homogeneous parts of a system, separated from one another by definite physical boundaries.

polarizability. Electrical deformability.

polarization. Deformation in an electrostatic field leading to the creation of temporary dipoles.

polar substance. An ionic substance or one whose molecules have a permanent dipole moment.

Raoult's law. A relationship between the mole fraction and partial pressure of the components of ideal solutions. It is expressed by $(p_i^o-p_i)/p_i^o = x_i$, where p_i^o is the vapor pressure of the pure component i at the given temperature and p_i is its partial pressure over the solution in which the mole fraction of i is x_i.

solidus. Temperature-concentration curve for the solid phase, when both solid and liquid solutions are formed (see liquidus).

transition point. Temperature at which a change from one state or form to another occurs.

triple point. The conditions under which three phases can exist in equilibrium.

van der Waals forces. Weak intermolecular forces resulting from induced temporary dipoles within the molecules.

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ORGANIC COMPOUND INDEX

Abbreviations used in the index

alc.	alcohol
aq.	aqueous
corr.	correction
C.S.T.	critical solution temperature
distr.	distribution data
f.pts.	freezing points
liq.-vap.	liquid-vapor
soln.	solution
soly.	solubility

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Acetic acid + Palmitonitrile, f.pts... 771

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Chloroform + 2,6 Lutidine, f. pts. 573
Chloroform + Myristonitrile, f. pts..... 761
Chloroform + Palmitonitrile, f. pts..... 771
Chloroform + Perfluoromethyl cyclohexane..... 573
Chloroform + Pyridine, f. pts.. 573
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Cyclohexane + Caprylic acid, f. pts..... 708
Cyclohexane + Chlorex, f. pts... 628
Cyclohexane + Dodecanol, f. pts. 730
Cyclohexane + Decylamine, f. pts. 732
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Cyclohexane + Dodecane, f. pts. 747
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Cyclohexane + Myristic acid, f. pts..... 763
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Cyclohexane + Nonylic acid, f. pts. 717
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Cyclohexane + Pentadecylic acid, f. pts..... 767
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